Operating Instructions (Edition 06/2005)

sinamics

Converter Cabinet Units
SINAMICS G150
75 kW to 1500 kW

SIEMENS

SIEMENS

SINAMICS G150

Version A and C

Operating Instructions
User Documentation

Valid for

Converter type	*Control version*
SINAMICS G150	V2.3

Edition 06/05

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For further information please visit us at:
http://www.ad.siemens.de

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We have checked the contents of this document for agreement with the hardware and software described. Nonetheless, differences might exist and therefore we cannot guarantee that they are completely identical. However, the data in this manual is reviewed regularly and any necessary corrections included in subsequent editions. We are thankful for any recommendations or suggestions.

We reserve the right to make technical changes.

Siemens AG

Preface

User documentation

WARNING

Before installing and commissioning the converter, make sure that you read all the safety notes and warnings carefully, including the warning labels on the equipment itself. The warning labels must always be legible. Missing or damaged labels must be replaced.

Further information is available from:

Technical support

Tel: +49 (0) 180 50 50 222

Fax: +49 (0) 180 50 50 223

Internet: http://www.siemens.com/automation/support-request

Internet Address

Information about SINAMICS can be found on the Internet at the following address:
http://www.siemens.com/sinamics

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■

Safety Information

1

1.1 Definitions and Warning Information

Qualified Personnel

For the purpose of this documentation and the product warning labels, a “qualified person” is someone who is familiar with the installation, mounting, start-up, operation and maintenance of the product. He or she must have the following qualifications:

- Trained or authorized to energize, de-energize, ground, and tag circuits and equipment in accordance with established safety procedures.
- Trained in the proper care and use of protective equipment in accordance with established safety procedures.
- First aid training.

DANGER

Indicates an imminently hazardous situation which, if not avoided, **will** result in death, serious injury, or substantial damage to property.

WARNING

Indicates an imminently hazardous situation which, if not avoided, **could** result in death, serious injury, or substantial damage to property.

CAUTION

Used together with the safety alert symbol, this indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or damage to property.

CAUTION

Used without the safety alert symbol, this indicates a potentially hazardous situation which, if not avoided, may result in damage to property.

IMPORTANT

Used without the safety alert symbol, this indicates a potential situation which, if not avoided, may lead to an undesirable result or state.

NOTE

This symbol always appears in this documentation where further, explanatory information is provided.

WARNING

Hazardous voltages are present in this electrical equipment during operation.
Non-observance of the warnings can result in severe personal injury or property damage.
Only qualified personnel should work on or around the equipment.
This personnel must be thoroughly familiar with all warning and maintenance procedures described in this documentation.
The successful and safe operation of this device is dependent on correct transport, proper storage and installation, as well as careful operation and maintenance.
National safety guidelines must be observed.

Certification

The following certificates can be found under “Safety and Operating Instructions” in the documentation folder:

- EU declaration of conformity
- Certificate of compliance with order
- EU manufacturer’s declaration

1.2 Safety and Operating Instructions

DANGER

This equipment is used in industrial high-voltage installations. During operation, this equipment contains rotating and live, bare parts. For this reason, they could cause severe injury or significant material damage if the required covers are removed, if they are used or operated incorrectly, or have not been properly maintained.
When the machines are used in non-industrial areas, the installation location must be protected against unauthorized access (protective fencing, appropriate signs).

Requirements

Those responsible for protecting the plant must ensure the following:

- The basic planning work for the plant and the transport, assembly, installation, commissioning, maintenance, and repair work is carried out by qualified personnel and/or checked by experts responsible.
- The operating manual and machine documentation are always available.
- The technical data and specifications regarding the applicable installation, connection, environmental, and operating conditions are always observed.
- The plant-specific assembly and safety guidelines are observed and personal protection equipment is used.
- Unqualified personnel are forbidden from using these machines and working near them.

This operating manual is intended for qualified personnel and only contain information and notes relating to the intended purpose of the machines.

The operating manual and machine documentation are written in different languages as specified in the delivery contracts.

NOTE

The services and support provided by the SIEMENS service centers are recommended for planning, installation, commissioning, and servicing work.

Components that can be Destroyed by Electrostatic Discharge (ESD)

CAUTION

The board contains components that can be destroyed by electrostatic discharge. These components can be easily destroyed if not handled properly. If you do have to use electronic boards, however, please observe the following:

- You should only touch electronic boards if absolutely necessary.
- When you touch boards, however, your body must be electrically discharged beforehand.
- Boards must not come into contact with highly insulating materials (such as plastic parts, insulated desktops, articles of clothing manufactured from man-made fibers).
- Boards must only be placed on conductive surfaces.
- Boards and components should only be stored and transported in conductive packaging (such as metalized plastic boxes or metal containers).
- If the packaging material is not conductive, the boards must be wrapped with a conductive packaging material (such as conductive foam rubber or household aluminum foil).

The necessary ESD protective measures are clearly illustrated in the following diagram:

- a = conductive floor surface
- b = ESD table
- c = ESD shoes
- d = ESD overall
- e = ESD chain
- f = cabinet ground connection
- g = contact with conductive flooring

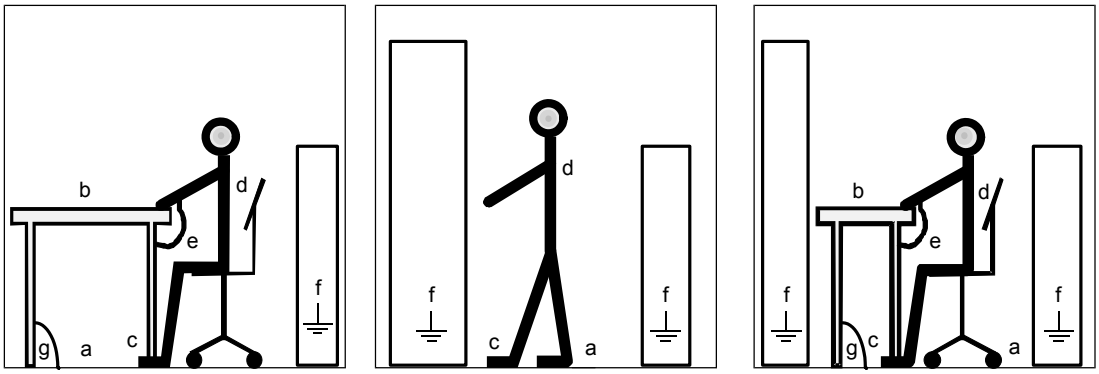

Fig. 1-1 ESD protective measures

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Device Overview

2

2.1 Chapter Content

This chapter provides information on the following:

- Introduction to the cabinet units
- The main components and features of the cabinet unit
- The cabinet unit wiring
- Explanation of the type plate

2.2 Applications, Features, and Design

2.2.1 Applications

SINAMICS G150 drive converter cabinet units are specially designed to meet the requirements of drives with a quadratic and constant load characteristic, medium performance requirements, and no regenerative feedback. Applications include:

- Pumps and fans
- Compressors
- Extruders and mixers
- Mills

2.2.2 Features

The accuracy of sensorless vector control ensures that the system can be used for a wide variety of applications and, as a result, an additional speed sensor is not required.

SINAMICS G150 takes this into account and, as a result, offers a low-cost drive solution tailored to actual requirements.

In addition, factors have been considered to ensure easy handling of the drive from the planning and design phase through to operation. These factors include:

- Compact, modular, service-friendly design
- Straightforward planning and design
- Ready to connect to facilitate the installation process
- Quick, menu-driven commissioning with no complex parameterization
- Clear and convenient operation via a user-friendly graphical operator panel with measured values displayed in plain text or in a quasi-analog bar display.
- SINAMICS is an integral part of Totally Integrated Automation (TIA). The TIA concept offers an optimized range of products for automation and drive technology. This concept is characterized by planning / design, communication, and data management procedures that are consistent throughout the product range. SINAMICS is totally integrated in the TIA concept.
  Separate S7/PCS7 blocks and faceplates for WinCC are available.

Quality

The SINAMICS G150 drive converter cabinet units are manufactured to meet high standards of quality and exacting demands.

This results in a high level of reliability, availability, and functionality for our products.

The development, design, and manufacturing processes, as well as order processing and the logistics supply center have been independently certified to DIN ISO 9001.

Service

Our worldwide sales and service network offers our customers individual consultations, provides support with planning and design, and offers a range of training courses.

For detailed contact information and the current link to our Internet pages, see 10.3.

2.3 Design

The SINAMICS G150 cabinet units are characterized by their compact, modular, and service-friendly design.

A wide range of electrical and mechanical components enable the drive system to be optimized for the appropriate requirements.

Two cabinet unit versions are available depending on the options that are chosen.

2.3.1 Version A

All the required power supply connection components, such as the main circuit-breaker, circuit-breakers, main contactor, line fuses, radio interference suppression filter, motor components, and additional protection and monitoring devices, can be installed as required.

The cabinet unit comprises up to four cabinet panels with a total width of between 800 and 3200 mm, depending on the output.

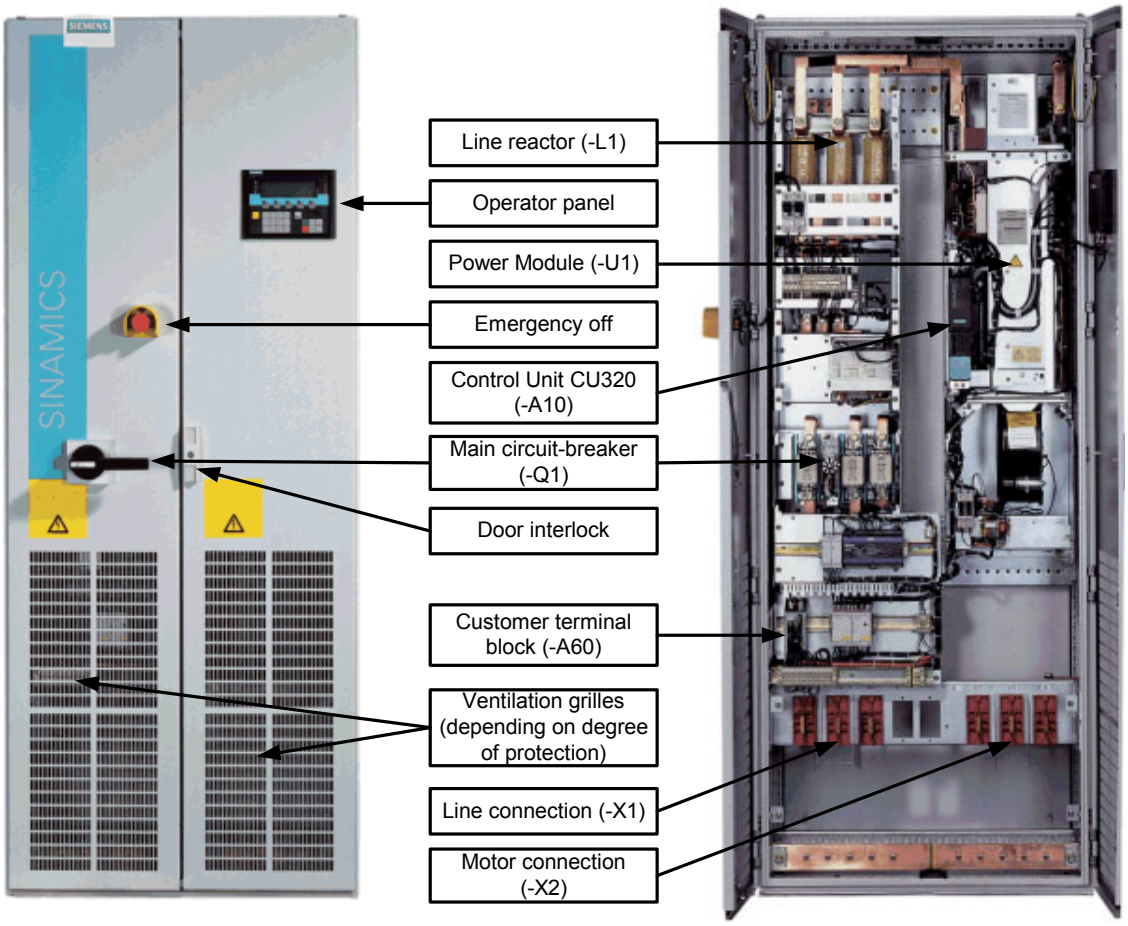


Fig. 2-1 Example of a cabinet unit, version A (e.g. 132 kW, 400 V 3AC) (some components are optional)

Version A, high power rating using a parallel circuit

For very high power ratings, the cabinet drive comprises two cabinet units that together drive a motor in a parallel circuit configuration:

- for 3-ph. 380 V – 480 V AC:
  6SL3710-2GE41-1AA0, 6SL3710-2GE41-4AA0, 6SL3710-2GE41-6AA0
- for 3-ph. 500 V – 600 V AC:
  6SL3710-2GF38-6AA0, 6SL3710-2GF41-1AA0, 6SL3710-2GF41-4AA0
- for 3-ph. 660 V – 690 V AC:
  6SL3710-2GH41-1AA0, 6SL3710-2GH41-4AA0, 6SL3710-2GH41-5AA0

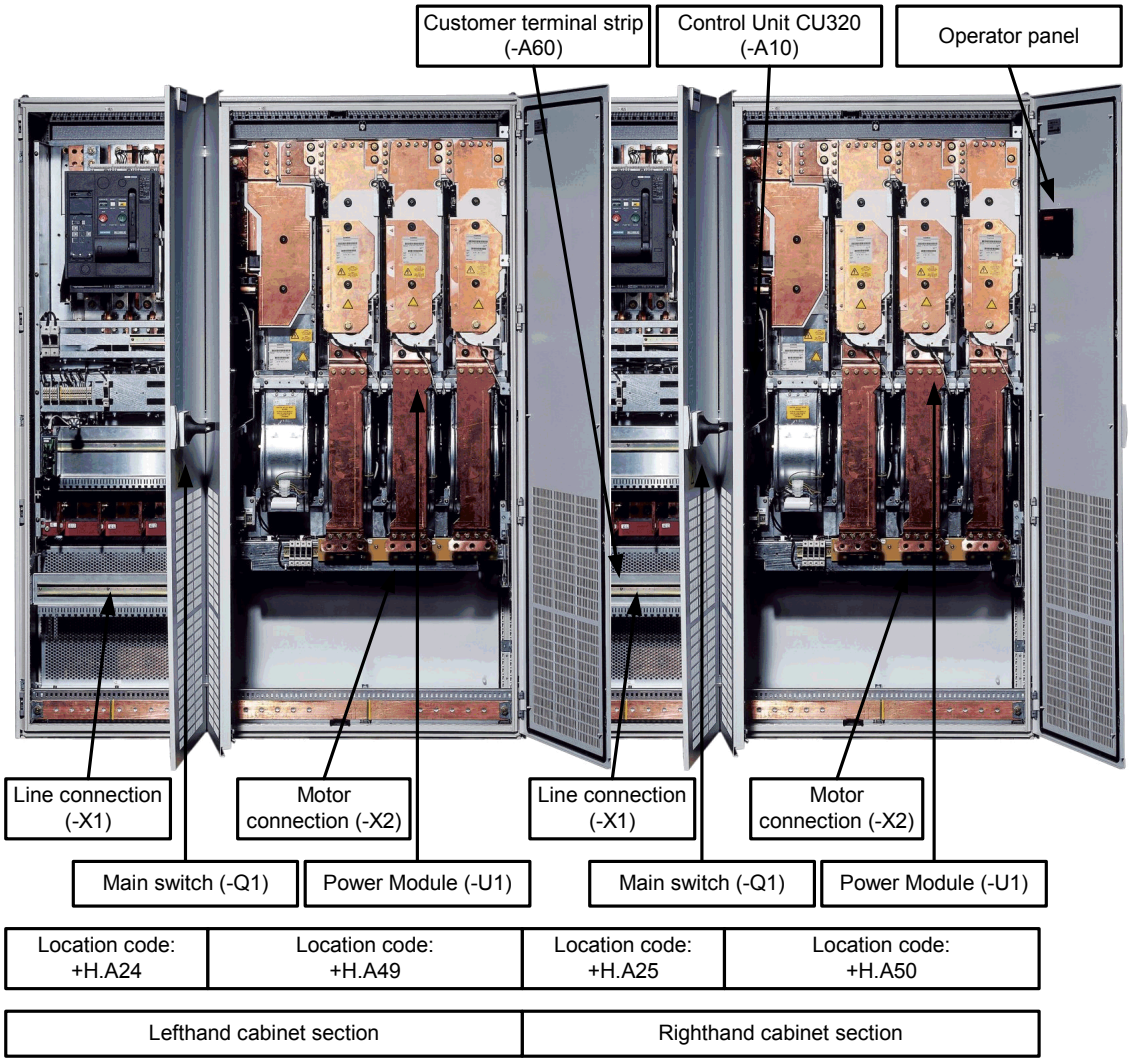


Fig.2-2 Example of the cabinet drive, version A (e.g. 1500 kW, 3-ph. 690 V AC), (components in some cases optional)

Special features when connecting-up and operating cabinet drive units in a parallel circuit configuration

The cabinet drive units can be connected to the line supply in either a 6-pulse or 12-pulse connection.

For a 6-pulse connection, the following special issues apply:

- The DC links may not be connected with one another, the disconnect switch (-Q98, -Q99) must be open.
- Only motors with separate winding systems may be used; every motor connection of a sub-cabinet must be connected to its own winding system. Parameter p7003 (winding system) must be set to "1" (several separate winding systems or motors).
- Edge modulation is not possible.

For a 12-pulse connection, the following special issues apply:

- The 12-pulse connection to the line supply is only possible using a double-tier transformer with three winding systems or two single transformers with two electrical winding systems on the transformer secondary offset through 30° with respect to one another.
  Transformer vector groups Dy5Dd0 or Dy11Dd0 should be preferably used.
  When using sub-windings that are electrically offset with respect to one another, the line harmonics are reduced with respect to the 6-pulse infeed.

  The following requirements apply for the transformer:

  - The open-circuit voltages of the two secondary windings must not differ more than a maximum of 0.5% (referred to rated voltage).
  - The deviations of the short-circuit impedances of the two secondary windings must be less than 5 % of the rated value.
  - The minimum short-circuit impedance of the transformer should be 4 %.
- The DC links must be connected with one another, the disconnect switch (-Q98, -Q99) must be closed.
- The feedback signal contacts of the main contactors and the circuit-breakers are connected in series in the factory and are connected to digital input 7 of the Control Unit.
  When commissioning the drive, the monitoring function of the feedback signals must be activated.
  This is realized using parameter p0860{Vector} = 722.7{Control Unit}.
- Motors with two electrically isolated winding systems and also motors with one winding system can be used.

When connecting a motor with one winding system, the following special features apply.

- The motor connections of the Power Modules can be connected to one another per phase. Parameter p7003 (winding system) must be set to "0" (one winding systems).
- If a motor reactor is not being used (option L08), the minimum motor cable lengths must be used – refer to Chapter 4.
- Edge modulation is not possible.

When connecting a motor with separate winding systems, the following special points apply.

- Every motor connection of a Power Module must be connected to its own winding system. Parameter p7003 (winding system) must be set to "1" (several separate winding systems or motors).
- Edge modulation is not possible.

2.3.2 Version C

This version is particularly compact in design with an in-built line reactor.

It can be used, for example, when the power supply connection components, such as the main contactor and main circuit-breaker with fuses for conductor protection and semi-conductor protection, are installed in an existing central low-voltage distribution unit (MCC).

The advantage here is that the cabinet unit can be sited decentrally and in the immediate vicinity of the motor, thereby avoiding the need for long motor cables and additional output filters.

Line fuses are required for conductor protection (VDE 636, Part 10). Line fuses can also be used to protect the semi-conductors of the line-commutated converter (VDE 636, Part 40/ EN 60 269-4).

The cabinet unit simply comprises a single cabinet with a width of 400 mm, 600 mm, or 1000 mm.

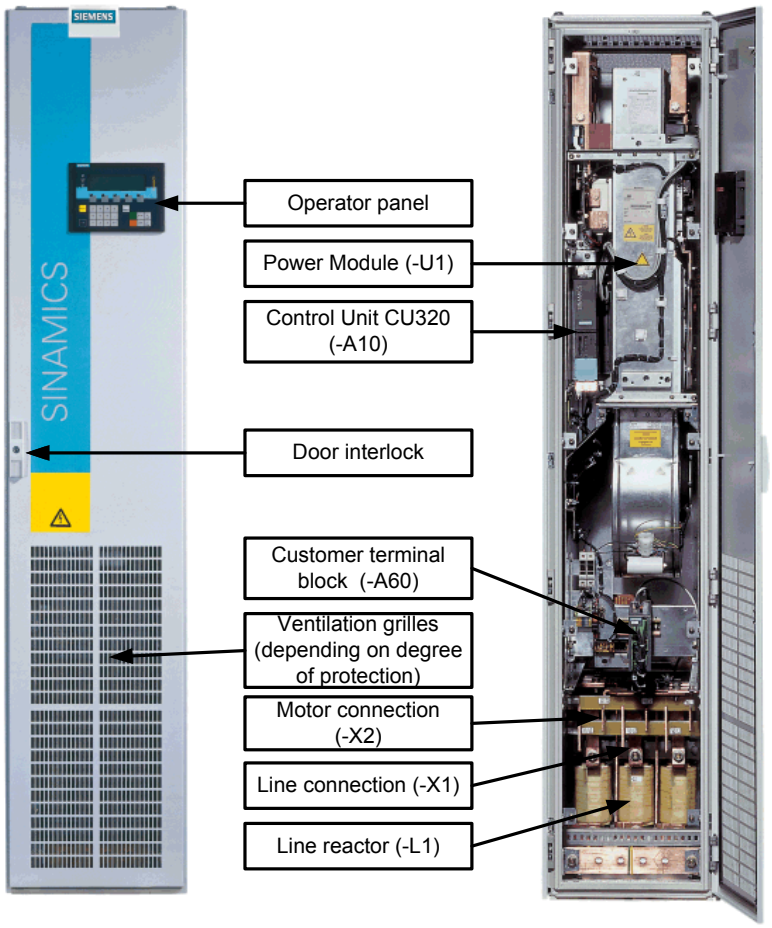
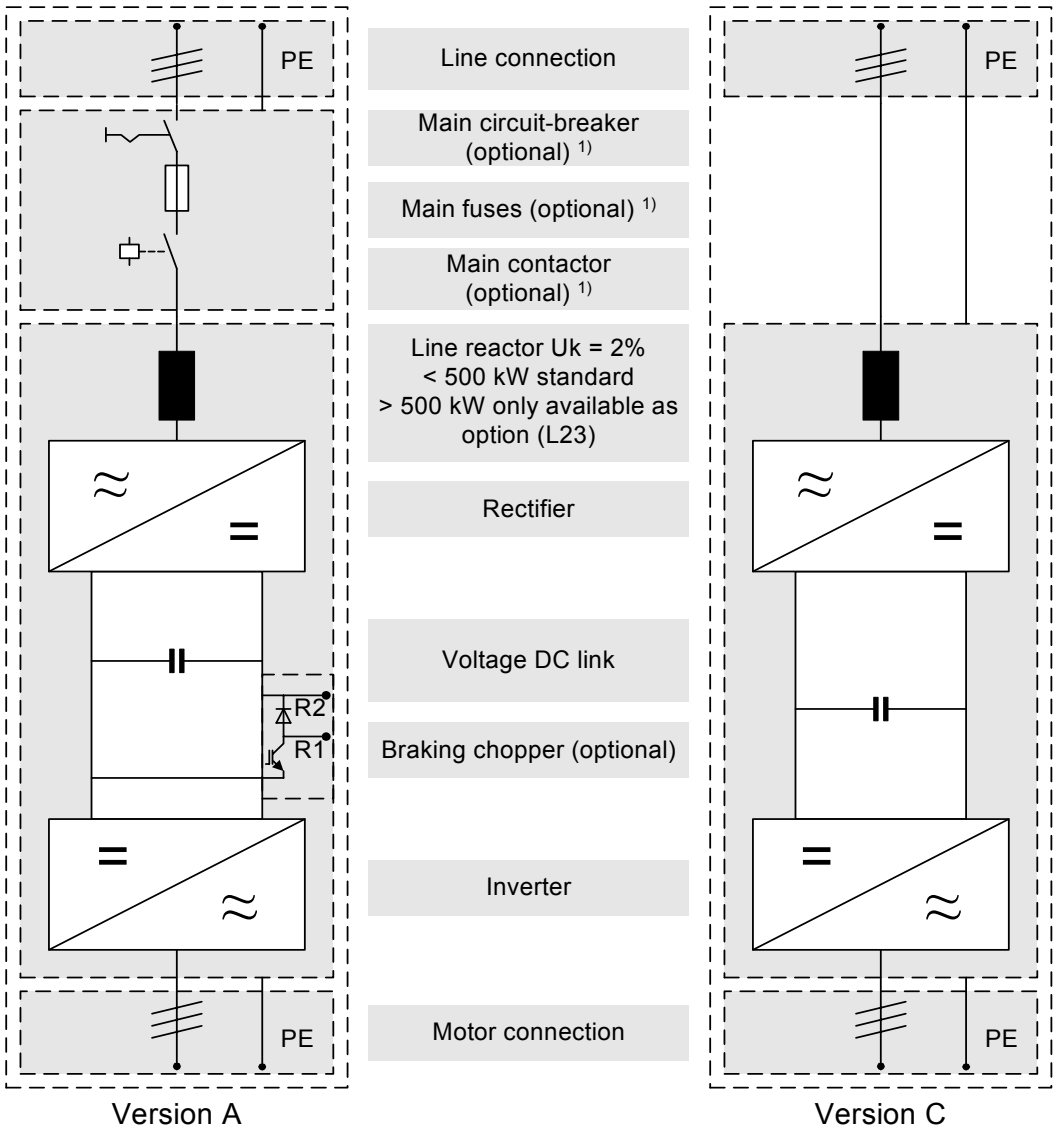


Fig. 2-3 Example of a cabinet unit, version C (e.g. 315 kW, 690 V 3AC)

2.4 Wiring Principle

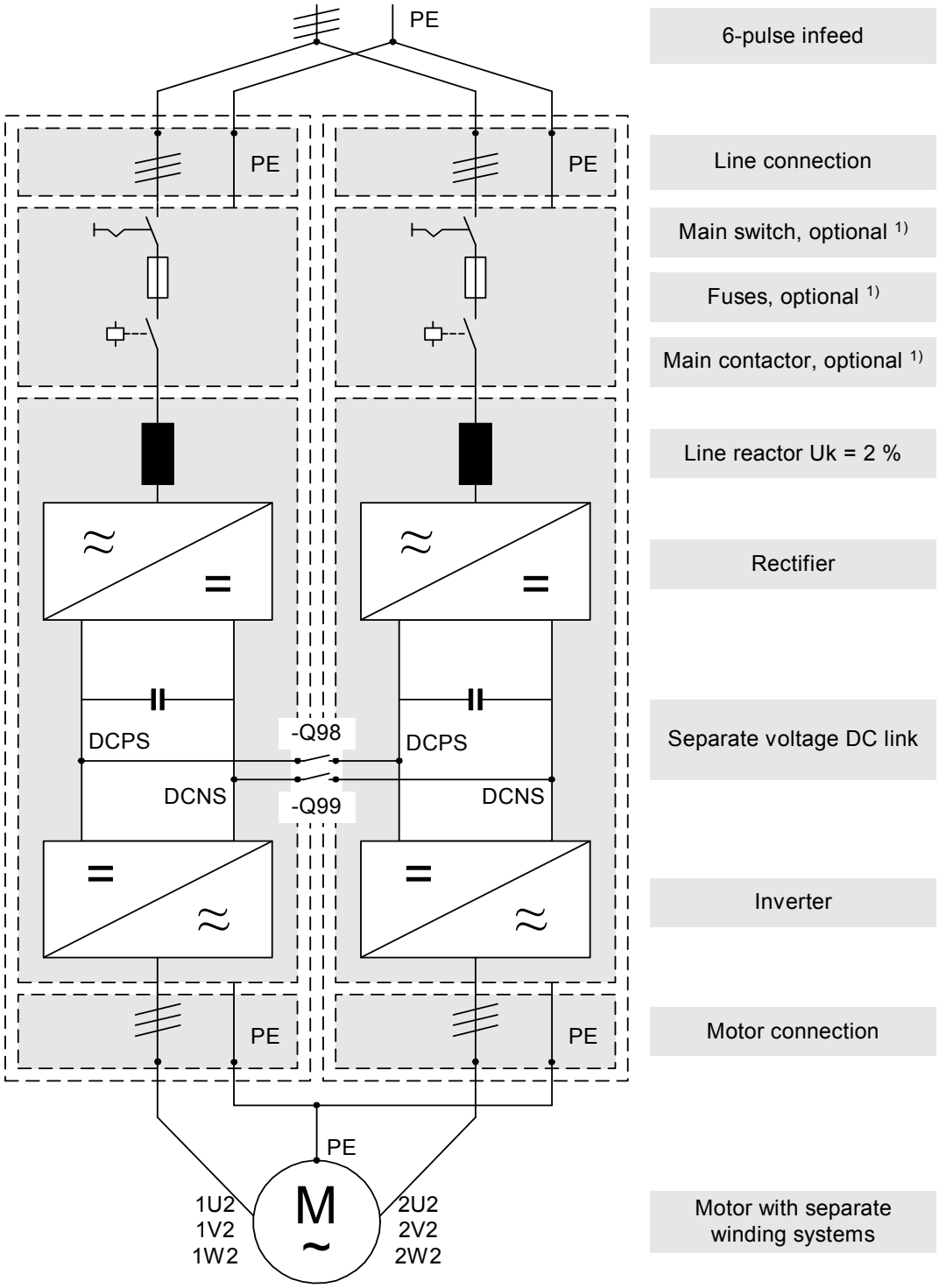
Wiring principle: versions A and C



1) The main-circuit breaker, fuse, and main contactor functions are implemented as of an output current of > 800 A by means of circuit-breakers.

Fig. 2-4 Wiring principle: versions A and C

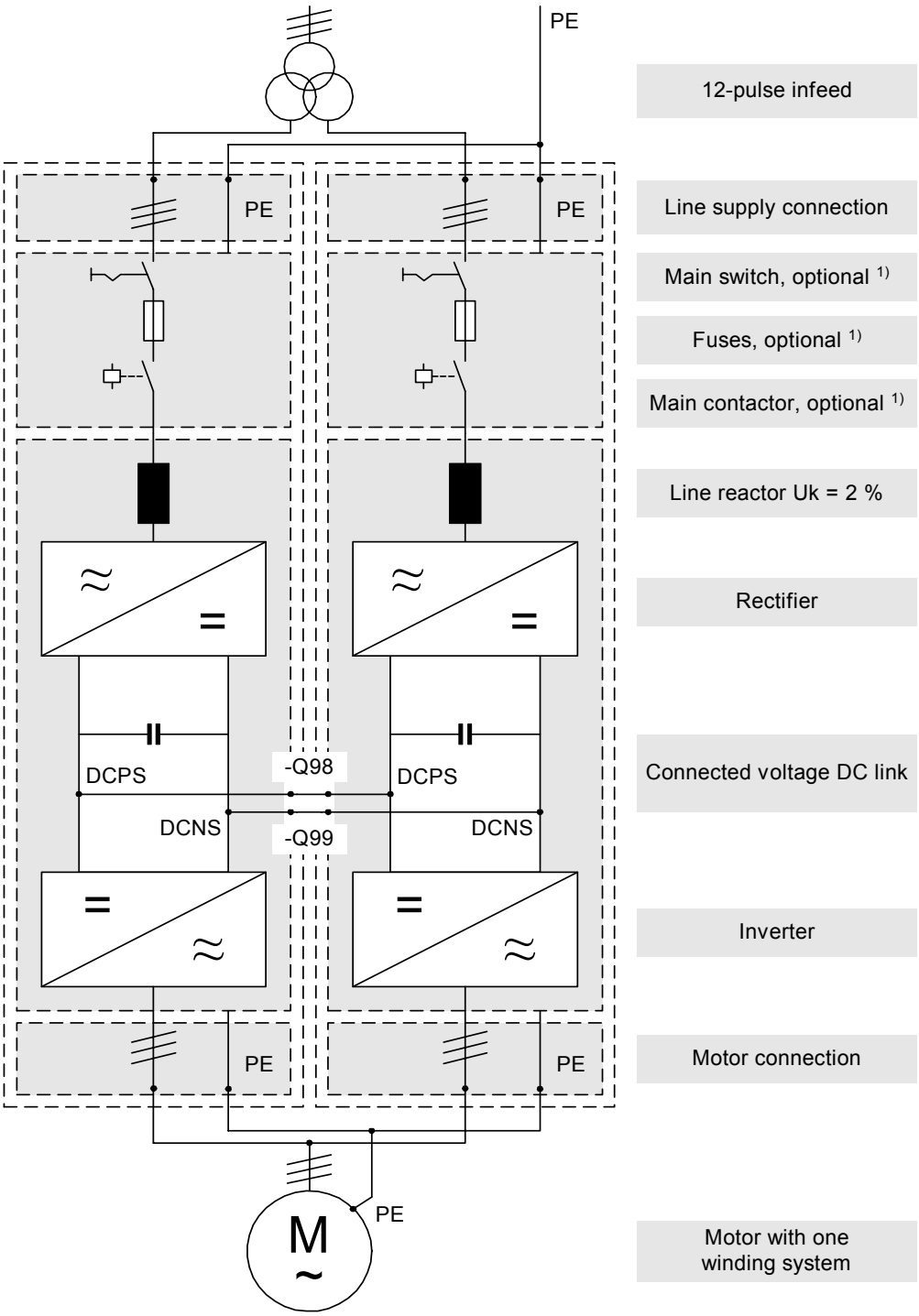
Circuit principle, Version A, parallel circuit with 6-pulse infeed



1) From an output current of > 800 A, the functions main switch, fuses and main contactor are implemented using a circuit-breaker

Fig.2-5 Circuit principle, Version A, parallel circuit, 6-pulse infeed, connected to one motor with separate winding systems.

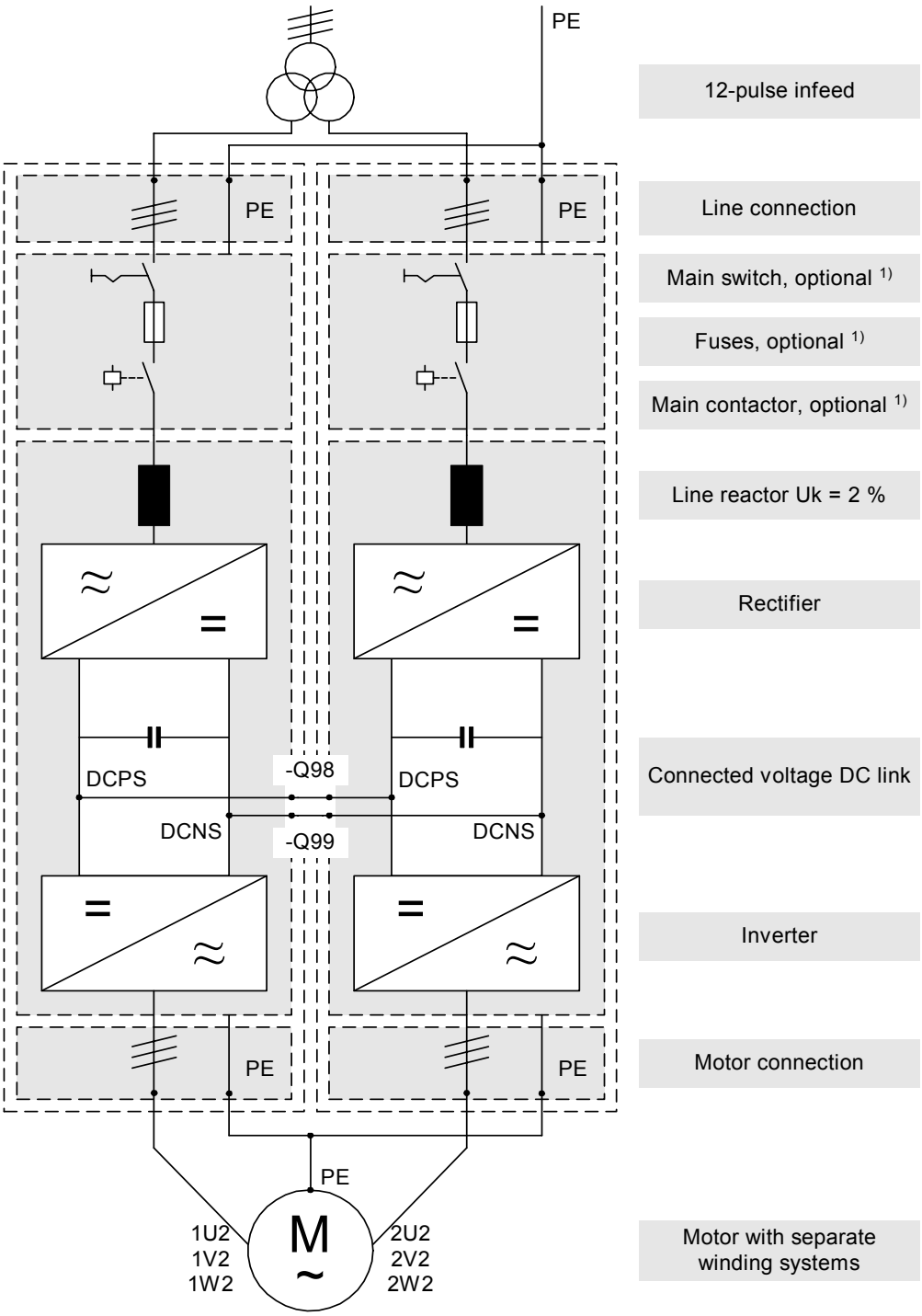
Circuit principle for a parallel circuit with 12-pulse infeed, motor with one winding system



1) From an output current of > 800 A, the functions main switch, fuses and main contactor are implemented using a circuit-breaker

Fig.2-6 Circuit principle, Version A, parallel circuit, 12-pulse infeed, connected to one motor with one winding system.

Circuit principle for a parallel circuit with 12-pulse infeed, motor with separate winding systems



1) From an output current of > 800 A, the functions main switch, fuses and main contactor are implemented using a circuit-breaker

Fig.2-7 Circuit principle for a parallel circuit, 12-pulse infeed, connected to a motor with separate winding systems.

IMPORTANT

The motor earth must be fed back directly to the cabinet unit.

2.5 Type Plate

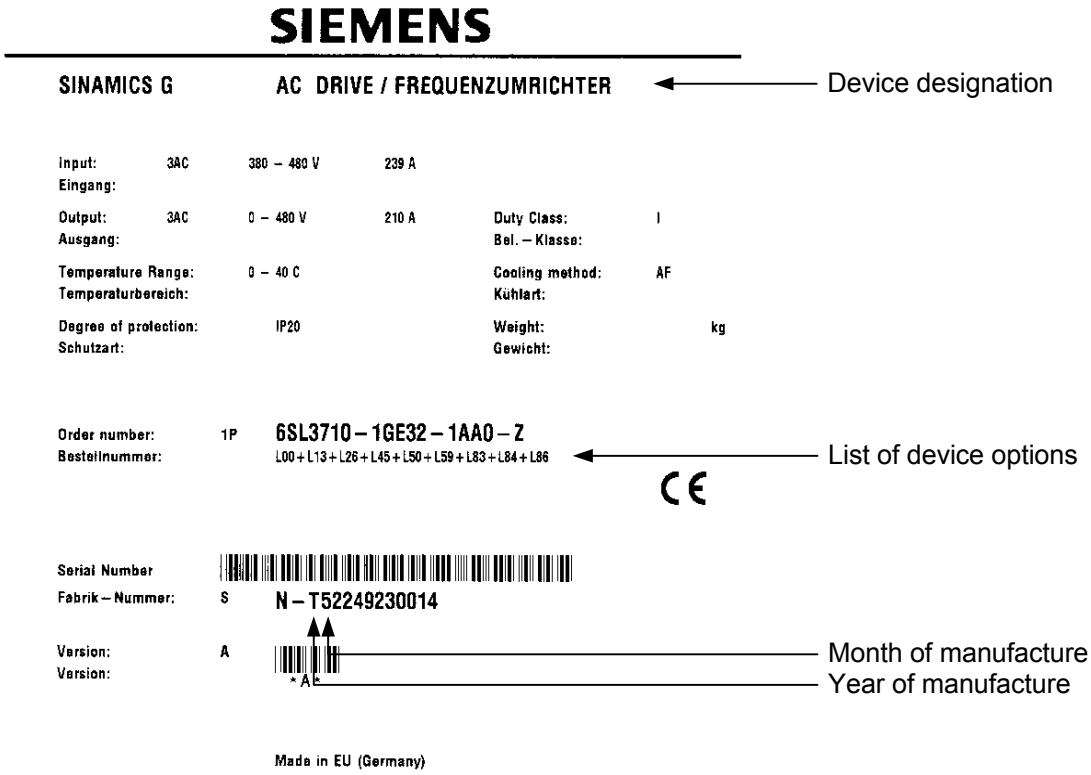


Fig. 2-8 Type plate for the cabinet unit

Date of Manufacture

The date of manufacture can be ascertained as follows:

Table 2-1 Year and month of manufacture

Letter / number	Year of manufacture		Letter / number	Month of manufacture
S	2004		1 to 9	January to September
T	2005		O	October
V	2006		N	November
Y	2007		D	December

Type Plate Data (from Type Plate on Previous Page)

Table 2-2 Type plate data

Specification	Value	Explanation
Input	3AC 380 – 480 V 239 A	Three-phase connection Rated input voltage Rated input current
Output	3AC 0 – 480 V 210 A	Three-phase connection Rated output voltage Rated output current
Temperature range	0 – 40°C	Ambient temperature range within which the cabinet unit can operate under 100 % load
Degree of protection	IP20	Degree of protection
Duty class	I	I: Duty class I to EN 60146-1-1 = 100 % (continuously) (with the specified current values, the cabinet unit can operate continuously under 100 % load)
Cooling method	AF	A: coolant: air F: circulation method: forced cooling, drive unit (fan) in the device
Weight		Weight of the cabinet unit

Explanation of the Option Short Codes

Table 2-3 Explanation of the option codes

		Version	
		A	C
Input options			
L00	Line filter for use in environment 1 to EN 61800-3, category C2 (TN/TT networks)	●	—
L13	Main contactor (for currents < 800 A)	●	—
L22	Without line reactor in power range P < 500 kW (available soon)	●	●
L23	Line reactor uk = 2 %, may be required for P > 500 kW	●	●
L26	Main circuit-breaker (incl. fuses/circuit-breakers)	●	—
Output options			
L08	Motor reactor	●	—
L15	Sinusoidal filter (only for the voltage range 380 – 480 V, max. 200 kW)	●	—
Input and output options			
M70	EMC shield bar (cable connection from below)	●	●
M75	PE busbar (cable connection from below)	●	●

		Version	
		A	C
Motor protection and safety functions			
L45	EMERGENCY OFF button in the cabinet unit door	●	–
L57	EMERGENCY OFF category 0 (230 V AC or 24 V DC, uncontrolled stop)	●	–
L59	EMERGENCY STOP category 1, 230 V AC, controlled stop	●	–
L60	EMERGENCY OFF category 1 (24 V AC, controlled stop)	●	–
L83	Thermistor motor protection unit with PTB approval (warning)	●	–
L84	Thermistor motor protection unit with PTB approval (shutdown)	●	–
L86	PT100 evaluation unit (for 6 PT100 sensors)	●	–
L87	Insulation monitoring	●	–
M60	Additional shock-hazard protection	●	●
Increase in degree of protection			
M21	IP21 degree of protection	●	●
M23	IP23 degree of protection	●	●
M54	IP54 degree of protection	●	●
Mechanical options			
M06	Plinth, 100 mm high, RAL 7022	●	●
M07	Cable wiring compartment, 200 mm high, RAL 7035	●	●
M13	Line connection from above	●	–
M78	Motor connection from above	●	–
M90	Top-mounted crane transport assembly for cabinets	●	●
Miscellaneous options			
G61	Customer terminal block extension TM31	●	–
K50	Sensor Module (SMC30) for detecting the actual motor speed	●	–
L19	Connection for external auxiliary equipment (controlled max. 10 A)	●	–
L50	Cabinet illumination with service socket	●	–
L55	Cabinet standstill heating	●	–
L61	25 kW braking unit	●	–
L62	50 kW braking unit	●	–
Y09	Special paint finish for cabinet	●	●
Languages			
D58	Documentation in English / French	●	●
D60	Documentation in English / Spanish	●	●
D80	Documentation in English / Italian	●	●
T58	Type plate and operator panel in English / French	●	●
T60	Type plate and operator panel in English / Spanish	●	●
T80	Type plate and operator panel in English / Italian	●	●
Industry-specific options (chemicals)			
B00	NAMUR terminal block	●	–
B02	Separate 24 V power supply (PELV)	●	–
B03	Outgoing section for external auxiliary equipment (uncontrolled)	●	–
B04	PROFIdrive NAMUR	●	–

- ● indicates that this option is available for that version.
- – indicates that this option is not available for that version.

■

Mechanical Installation

3

3.1 Chapter Content

This chapter provides information on the following:

- The conditions for transporting, storing, and installing the cabinet unit
- Preparing and installing the cabinet unit

3.2 Transportation and Storage

Transportation

WARNING

The following must be taken into account when the devices are transported:

- The devices are heavy. Their center of gravity is displaced, and they can be top heavy.
- Suitable hoisting gear operated by trained personnel is essential due to the weight of the devices.
- The devices must only be transported in the upright position indicated. The devices must not be transported upside down or horizontally.
- Serious injury or even death and substantial material damage can occur if the devices are not lifted or transported properly.

NOTES regarding transportation

- The devices are packaged by the manufacturers in accordance with the climatic conditions and stress encountered during transit and in the recipient country.
- The notes on the packaging for transportation, storage, and proper handling must be observed.
- The devices must be carried on a wooden palette when transported with fork-lift trucks.
- When the devices are unpacked, they can be transported using the optional transport eyebolts (option M90) or rails on the cabinet unit. The load must be distributed evenly. Heavy blows or impacts must be avoided during transit and when the devices are being set down, for example.
- Permissible ambient temperatures:
  Ventilation: -25°C to +70°C, class 2K3 to IEC 60 721-3-2
  Up to -40°C for max. 24 hours

NOTES regarding built-in system-side components

If built-in system-side components are to be installed on doors or side panels, you must take into account the following points:

- The degree of protection (IP20, IP21, IP23, IP54) must not be reduced as a result.
- The electromagnetic compatibility of the cabinet unit must not be adversely affected.
- When control elements are installed on side or rear panels, the panels must be grounded separately.

NOTES regarding damage in transit

- Carry out a thorough visual inspection of the device before accepting the delivery from the transportation company.
- Ensure that you have received all the items specified on the delivery note.
- Notify the transportation company immediately of any missing components or damage.
- If you identify any hidden deficiencies or damage, contact the transportation company immediately and ask them to examine the device.
- If you fail to contact them immediately, you may lose your right to claim compensation for the deficiencies and damage.
- If necessary, you can request the support of your local Siemens branch.

WARNING

Damage in transit indicates that the device was subject to unreasonable stress. The electrical safety of the device can no longer be ensured. It must not be connected until a thorough high-voltage test has been carried out.

Death, serious injury, or substantial material damage can result if these factors are not taken into account.

Storage

The devices must be stored in clean, dry rooms. Permissible temperatures: between –25°C and +70°C. Temperature variations greater than 20 K per hour are not permitted.

If the device is stored for a prolonged period once it has been unpacked, cover it or take other appropriate measures to ensure that it does not become dirty and that it is protected against environmental influences. If such measures are not taken, the guarantee becomes invalid in the event of a claim for damages.

WARNING

The storage period should not exceed two years. If the device is stored for more than two years, the DC link capacitors of the devices must be reformed during commissioning.

The reforming procedure is described in "Maintenance and Servicing”.

3.3 Installation

WARNING

To ensure that the devices operate safely and reliably, they must be properly installed and put into operation by qualified personnel, taking into account the warning messages provided in this operating manual.

In particular, both the general and national installation and safety guidelines for high-voltage installations (e.g. VDE – the Union of German Technical Engineers) and the guidelines relating to the professional use of tools and the use of personal protective equipment must be observed.

Death, serious injury, or substantial material damage can result if these factors are not taken into account.

3.3.1 Mechanical Installation: Checklist

Use the following checklist to guide you through the mechanical installation procedure for the cabinet unit. Read the safety notes at the start of this operating manual before you start working on the device.

NOTE

Check the boxes accordingly in the right-hand column if the activity applies to the cabinet unit in your scope of supply. In the same way, check the boxes once you have finished the installation procedure to confirm that the activities are complete.

Item	Activity	Fulfilled/Complete
1	The ambient conditions must be permissible. See "Technical Data, General Technical Data". The cabinet unit must be firmly attached to the fixing points provided. With version C with a width of 400 mm, the cabinet unit can, if required, be secured to a non-flammable vertical surface by means of the wall support supplied (see 3.3.2). The cooling air can flow unobstructed.	☐ ☐
2	The minimum ceiling height (for unhindered air outlet) specified in the operating manual must be observed. The cooling air supply must be not be obstructed (see 3.3.2).	☐ ☐
3	Transport units separately shipped must be connected to one another (refer to Chapter 3.3.4).	☐ ☐
4	Components that are supplied separately for transport reasons (canopy or hood) must be fitted (see 3.3.5).	☐ ☐
5	The clearance around an open door (escape route) specified in the applicable accident prevention guidelines must be observed.	☐ ☐
6	For option M13/M78: Choose the required metric screw connections or conduit thread connections on the basis of the cable cross-section and drill the required holes in the blanking plates. When the cable is fed in from above, ensure that enough room is available if the cable has to be bent because of the cable feeder and cross-sections. The cable entries should be fed in vertically to minimize transverse forces on the entries (see 3.3.6).	☐ ☐

3.3.2 Preparatory Steps

On-Site Requirements

The cabinet units are suitable for installation in general operating areas (DIN VDE 0558 / Edition 7.87, Part 1 / Section 5.4.3.2.4).

The standard specifies the following:

When power conversion units are installed in general operating areas, live parts must be protected in such a way that they cannot be touched either directly or indirectly.

The operating areas must be dry and free of dust. The air supplied must not contain any electrically conductive gas, vapors, or dust, which could impair the function of the devices. It may be necessary to filter the air supplied to the installation room. If the air contains dust, filter mats (option M54) can be installed in front of the hoods (IP54) and the ventilation grilles on the cabinet doors.

The ambient conditions for the units in the operating rooms must not exceed the values of code F in accordance with EN 60146. At temperatures > 40°C (104°F) and altitudes > 2000 m, the devices must be derated.

The basic version of the cabinet units complies with the IP20 degree of protection in accordance with EN 60529.

The chassis units are installed in accordance with the dimension drawings supplied. The clearance between the top of the cabinet unit and the ceiling is also specified on the dimension drawings.

The cooling air for the power unit is drawn in from the front through the ventilation grilles in the lower part of the cabinet doors. The warmed air is expelled through the perforated top cover or the ventilation grilles in the top cover (with option M13/M23/M54/M78). Cooling air can also be supplied from below through raised floors or air ducts, for example. To allow this, you have to create openings in the 3-section bottom plate.

According to EN 61800-3, the cabinet units are not suitable for use in low-voltage public networks that supply residential buildings. High-frequency interference may occur if they are used in this type of network.

Unpacking the Cabinets

Check the delivery against the delivery note to ensure that all the items have been delivered. Check that the cabinet is intact.

The packaging material must be discarded in accordance with the applicable country-specific guidelines and rules.

Required Tools

To install the cabinet, you will require:

- Spanner or socket spanner (w/f 10)
- Spanner or socket spanner (w/f 13)
- Spanner or socket spanner (w/f 16/17)
- Spanner or socket spanner (w/f 18/19)
- Hexagon-socket spanner (size 8)
- Torque spanner, max. 50 Nm
- Screwdriver, size 2
- Screwdriver Torx T20
- Screwdriver Torx T30

3.3.3 Installation

Lifting the Cabinet off the Transport Palette

The applicable local guidelines regarding the transportation of the cabinet from the transport palette to the installation location must be observed.

A crane transport assembly (option M90) can also be fitted on the top of the cabinet.

Installation

Four holes for M12 screws are provided on each cabinet panel to secure the cabinet to the ground. The fixing dimensions are specified on the dimension drawings enclosed.

Two wall supports for attaching the top of the cabinet to the wall are also supplied for 400 mm-wide cabinets to provide extra security.

3.3.4 Mechanically connecting separately shipped transport units

The following cabinets are supplied in the form of two separate transport units:

- 3-ph. 500 V – 600 V AC: 6SL3710-2GF41-4AA0
- 3-ph. 660 V – 690 V AC: 6SL3710-2GH41-4AA0, 6SL3710-2GH41-5AA0

The lefthand sub-cabinet has the locator code "+H.A24" and "+H.A49", the righthand sub-cabinet has the locator code "+H.A25" and "+H.A50" – the cabinet operator panel is also mounted here.

A series of connectors is provided attached loose with the equipment to mechanically connect the two sub-cabinets. These connectors should be attached and as far as possible evenly distributed.

3.3.5 Fitting Additional Canopies (Option M21) or Hoods (Option M23 / M54)

To increase the degree of protection of the cabinets from IP20 (standard) to IP21, IP23, or IP54, additional canopies or hoods are supplied. These must be fitted once the cabinets have been installed.

Description

The degree of protection can be increased to IP21 by fitting an additional canopy. The canopy is flush-mounted with the cabinet unit and is fitted using spacers at a distance of 250 mm above the top of the cabinet. As a result, cabinets with a canopy are 250 mm higher.

Cabinet units with degree of protection IP23 are supplied with additional hoods, as well as plastic ventilation grilles and braided plastic in the air inlet (doors) and outlet (hoods). The hoods are flush with the cabinets at the side and front and have a recess at the rear so that air can escape even if the cabinet is wall mounted. Air escapes from the front and back. The hood is secured by means of the four holes for the crane hook in the cabinet. Hoods increase the height of the cabinet by 400 mm.

Cabinet units with degree of protection IP54 are supplied with additional hoods, plastic ventilation grilles, and a filter medium in the air inlet (doors) and outlet (hoods). The filter mediums can be easily fitted and replaced from the outside. Air escapes from the front and back. Compliance with degree of protection IP54 requires an intact filter medium, which must be replaced on a regular basis due to the prevailing ambient conditions.

Attaching a Canopy to Increase the Degree of Protection to IP21 (Option M21)

1. Remove the crane transport assembly (if fitted).
2. Attach the spacers to the roof of the cabinet at the positions specified. You may have to remove the protective grille.
3. Fit the canopy to the spacers.

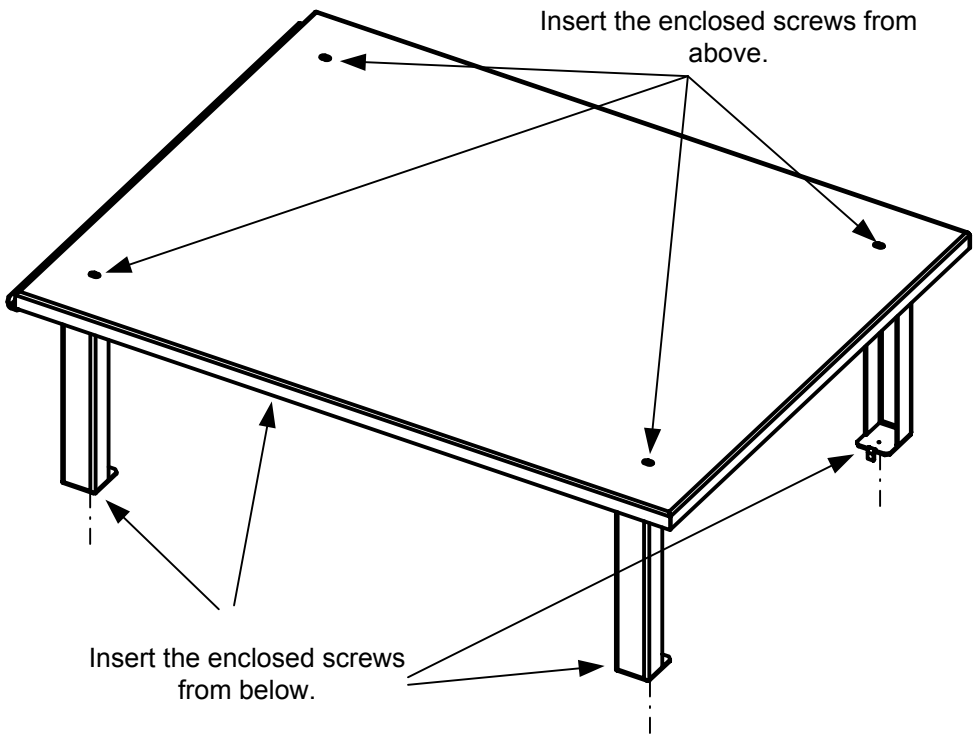


Fig. 3-1 Cabinet with attached canopy

Attaching a Hood to Increase the Degree of Protection to IP23 / IP54 (Option M23 / M54)

1. Remove the crane transport assembly (if fitted).
2. Make sure that the perforated top cover is not fitted on the top of the cabinet (depending on production requirements, this can be fitted at a later stage).
3. For option M54 only:
   Secure the contact surfaces of the hood on top of the cabinet using the sealing tape provided.
4. Fit the hood to the roof of the cabinet at the positions specified (fixing points for the crane transport assembly).

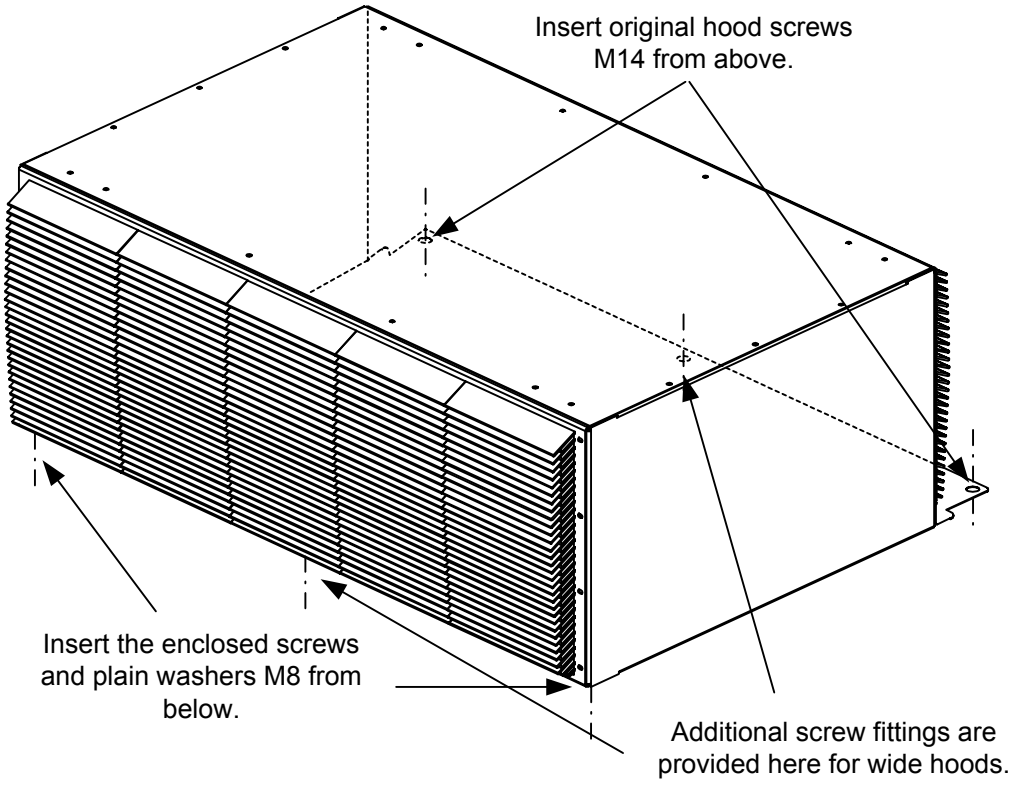


Fig. 3-2 Attaching a hood

3.3.6 Cable Entry from Above (Option M13), Motor Connection from Above (Option M78)

Cable Entry from Above

With options M13 and M78, the cabinet unit is equipped with an additional hood. The connection straps for the power cables, the clamping bar for mechanically securing the cables, an EMC shield bus, and a PE busbar are located within the hood.

The hood adds an extra 405 mm to the cabinet height. The busbars for connection from above are fully mounted when the system is delivered. For transport reasons, the hoods are delivered separately and must be mounted on site. With options M23 and M54, plastic ventilation grilles and filter mats are also supplied.

A 5 mm aluminum mounting plate (with no holes) is fitted in the roof of the cover for feeding in the cables. Depending on the number of cables and the cross-sections used, holes for attaching cable glands for feeding in the cables must be drilled in this mounting plate on site.

NOTE

The control cables and optional brake resistors are connected as before from below.

Attaching the Hood

1. Remove the crane transport assembly (if fitted).
2. For option M54 only:
   Secure the contact surfaces of the hood on top of the cabinet using the sealing tape provided.
3. Fit the hood to the roof of the cabinet at the positions specified (fixing points for the crane transport assembly).
4. To secure the power cables, remove the front panel of the hood.

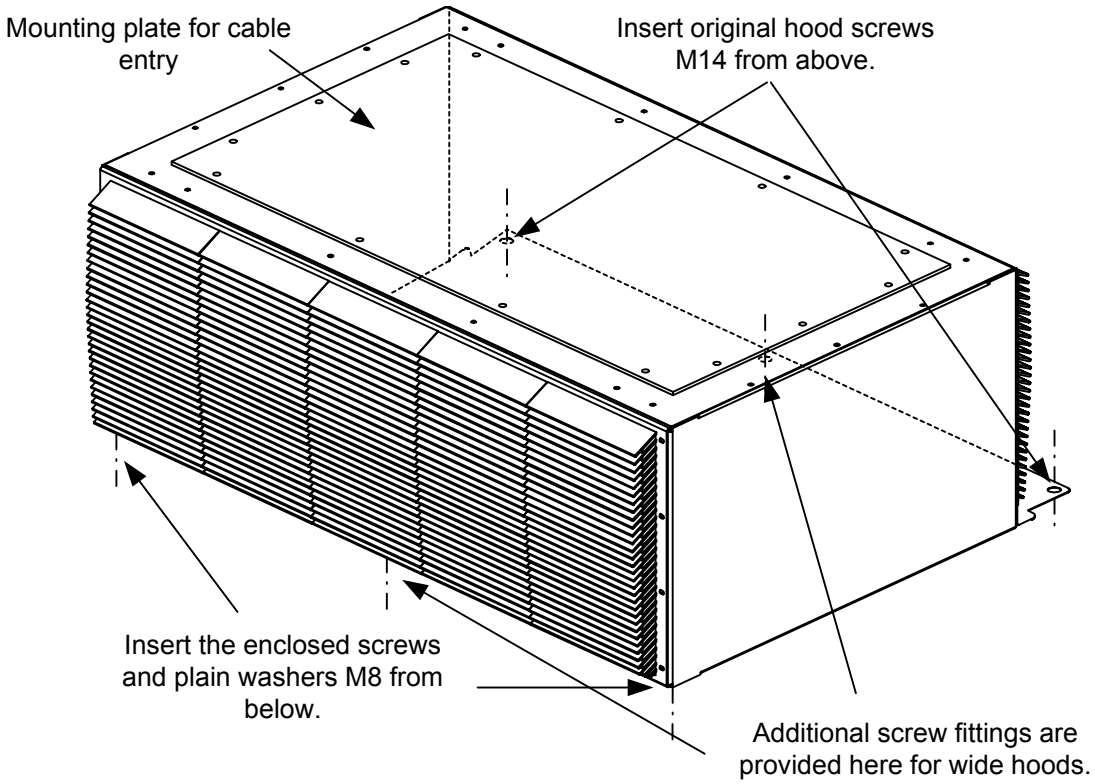

Mounting plate for cable entry
Insert original hood screws M14 from above.
Insert the enclosed screws and plain washers M8 from below.
Additional screw fittings are provided here for wide hoods.

Fig. 3-3 Attaching the hood with M13 / M78

■

Electrical Installation

4

4.1 Chapter Content

This chapter provides information on the following:

- Establishing the electrical connections for the cabinet unit
- Adjusting the fan voltage and the internal power supply to local conditions (supply voltage).
- The customer terminal block and its interfaces
- The interfaces for additional options

4.2 Electrical Installation: Checklist

Use the following checklist to guide you through the electrical installation procedure for the cabinet unit. Read the safety notes at the start of this operating manual before you start working on the device.

NOTE

Check the boxes accordingly in the right-hand column if the activity applies to the cabinet unit in your scope of supply. In the same way, check the boxes once you have finished the installation procedure to confirm that the activities are complete.

Item	Activity	Fulfilled/Complete	
	Power Connections		
1	For transport units that have been separately shipped, the electrical connections of the two sub-cabinets must be established (refer to Chapter 4.6).	☐	☐
2	The line-side and motor-side power cables must be dimensioned and routed in accordance with the ambient and routing conditions. The maximum permissible cable lengths between the converter and motor must be observed depending on the type of cable used (see Section 4.7.1). The motor ground must be fed back directly to the cabinet unit. The cables must be properly connected with a torque of 50 Nm to the cabinet unit terminals. The cables for the motor and low-voltage switchgear must also be connected with the required torques.	☐	☐
3	For very high power ratings, the disconnect switches (-Q98, -Q99) of the DC link connections must be closed or opened together (refer to Chapter 4.7.2).	☐	☐
4	The cables between the low-voltage switchgear and the cabinet unit must be protected with line fuses for conductor protection (VDE 636, Part 10). With version C, combined fuses must be used for conductor and semi-protection (VDE636, Part 40 / EN60269-4). See “Technical Data” for the appropriate fuses.	☐	☐
5	For strain relief, the cables must be clamped on the cable clamping bar (C-bar).	☐	☐
6	When EMC-shielded cables are used, screwed glands that connect the shield to ground with the greatest possible surface area must be provided on the motor terminal box. On the cabinet, the cables must be grounded with the clips supplied with the EMC shield bus with the greatest possible surface area (Shield bar supplied with option L00 or can be ordered separately with option M70.) (See Section 4.5.)	☐	☐
7	The cable shields must be properly applied and the cabinet properly grounded at the appropriate points (see Section 4.5).	☐	☐
8	The voltage for the fan transformer (-U1-T10) for versions A and C, and the internal power supply (-A1-T10) for version A (options L13, L26, L83, L84, L86, and L87 only) must be adapted to the supply voltage for the cabinet unit (see Section 4.7.4).	☐	☐

Item	Activity		Fulfilled/Complete
9	Before the cabinet is operated from an ungrounded supply/IT supply, the connection bracket for the basic interference suppression device must be removed (see Section 4.7.6).		☐ ☐
10	The type plate can be used to ascertain the date of manufacture. If the period from the date of manufacture to initial commissioning or the cabinet unit downtime is less than two years, the DC link capacitors do not have to be reformed. If the downtime period is longer than two years, they must be reformed in accordance with the description in the "Maintenance and Servicing" section.		☐ ☐
11	With an external auxiliary supply, the cable for the 230 V AC supply must be connected to terminal -X40, while the cable for the 24 V DC supply must be connected to terminal –X9 (see Section 4.8).		☐ ☐
12	Option L15 Sinusoidal filter	The filter must be selected during commissioning via STARTER or AOP30. You are advised to check your selection by checking the setting p0230 = 3. Any required parameterization is carried out automatically (see Section 4.10.2).	☐ ☐
13	Option L19 Connection for external auxiliary equipment	To supply auxiliary equipment (e.g. separately-driven fan for motor), the drive must be properly connected to terminals -X155:1 (L1) to -X155:3 (L3). The supply voltage of the auxiliary equipment must match the input voltage of the cabinet unit. The load current must not exceed 10 A and must be set in accordance with the connected consumer (see Section 4.10.3).	☐ ☐ Set value: ☐
14	Option L50 Cabinet illumination with socket	The 230 V auxiliary supply for the cabinet illumination with an integrated service socket must be connected to terminal -X390 and, on the system side, protected with a fuse (max. 10 A) (see Section 4.10.6).	☐ ☐
15	Option L55 Anti-condensation heating for cabinet	The 230 V auxiliary supply for the anti-condensation heating for the cabinet (230 V / 50 Hz, 100 W / or 230 V / 50 Hz 2 x 100 W for cabinets with a width of 800 to 1200 mm) must be connected to terminals -X240: 1 to 3 and protected with fuses (max. 16 A) (see Section 4.10.7).	☐ ☐
	Signal Connections		
16	Cabinet unit operation by higher-level controller / control room. The control cables must be connected in accordance with the interface assignment and the shield applied. Taking into account electrical interference and the distance from power cables, the digital and analog signals must be routed with separate cables. When the analog inputs on the customer terminal block are used as current or voltage inputs, selectors S5.0 and S5.1 must be set accordingly (see Section 4.9.1).		☐ ☐

Item	Activity		Fulfilled/Complete
17	Option K50 SMC30 sensor module	The SMC30 sensor module is used for determining the actual motor speed. The following encoders are supported by the SMC30 sensor module: • TTL encoder • HTL encoder In the factory setting, an HTL encoder is bipolar with 1024 pulse per revolution (see Section 4.10.15).	☐ ☐
	Connecting protection and monitoring devices		
18	Option L45 EMERGENCY OFF button	The contacts for the EMERGENCY OFF button are connected to terminal -X120 and can be picked off so that they can be integrated in a higher-level installation protection concept (see Section 4.10.5).	☐ ☐
19	Option L57 EMERGENCY OFF category 0 (230 V AC / 24 V DC)	EMERGENCY OFF category 0 stops the drive in an uncontrolled manner. No additional wiring is necessary when implemented in conjunction with option L45. If the cabinet unit is integrated in an external safety circuit, however, the contact must be looped in via terminal block -X120 (see Section 4.10.8).	☐ ☐
20	Option L59 EMERGENCY OFF category 1 (230 V AC)	EMERGENCY OFF category 1 stops the drive in a controlled manner. With this option, it may be necessary to implement braking units (brake chopper and external braking resistors) due to the load characteristic and to achieve the required shutdown times. No additional wiring is necessary when implemented in conjunction with option L45. If the cabinet unit is integrated in an external safety circuit, however, the contact must be looped in via terminal block -X120 (see Section 4.10.9).	☐ ☐
21	Option L60 EMERGENCY OFF category 1 (24 V DC)	EMERGENCY OFF category 1 stops the drive in a controlled manner. With this option, it may be necessary to implement braking units (brake chopper and external braking resistors) due to the load characteristic and to achieve the required shutdown times. No additional wiring is necessary when implemented in conjunction with option L45. If the cabinet unit is integrated in an external safety circuit, however, the contact must be looped in via terminal block -X120 (see Section 4.10.10).	☐ ☐
22	Option L61/L62 25 / 50 kW braking unit	The connecting cables and ground for the braking resistor must be connected to terminal block –X5: 1/2. A connection must be established between the braking resistor thermostat and customer terminal block –A60. The settings for evaluating the thermostat as "External Fault 3" must be made (see Section 4.10.11).	☐ ☐
23	Option L83 Thermistor motor protection unit (warning)	The PTC thermistor sensors (PTC resistor type A) must be connected to the thermistor motor protection unit -F127 at terminals T1 and T2 for warning (see Section 4.10.12).	☐ ☐

Item	Activity		Fulfilled/Complete
24	Option L84 Thermistor motor protection unit (shutdown)	The PTC thermistor sensors (PTC resistor type A) must be connected to the thermistor motor protection unit -F125 at terminals T1 and T2 for shutdown (see Section 4.10.12).	☐ ☐
25	Option L86 PT100 evaluation unit	The resistor thermometers must be connected to evaluation unit -A140 for the PT100 evaluation. The two-wire or three-wire system can be used here to connect the PT100 sensors. The sensors are divided into two groups (see Section 4.10.13). This must be taken into account when the evaluation is performed (factory setting).	☐ ☐
26	Option L87 Insulation monitoring	The insulation monitor can only be operated with the insulated-neutral system. Only one insulation monitor may be used in one electrically connected network. For system-side control, the signaling relays must be connected accordingly or, with individual drives (the cabinet unit is fed via a converter transformer assigned to the cabinet unit), integrated in the cabinet unit warning train (see Section 4.10.14). Point 9 must also be taken into account here: “Before the cabinet is operated from an ungrounded supply/IT supply, the connection bracket for the basic interference suppression device must be removed (see Section 4.7.6).”	☐ ☐

Required Tools

To install the connections, you will require:

- Spanner or socket spanner (w/f 10)
- Spanner or socket spanner (w/f 13)
- Spanner or socket spanner (w/f 16/17)
- Spanner or socket spanner (w/f 18/19)
- Hexagon-socket spanner (size 8)
- Torque spanner, max. 50 Nm
- Screwdriver, size 2
- Screwdriver Torx T20
- Screwdriver Torx T30

4.3 Important Safety Precautions

WARNING

The cabinet units are operated with high voltages.
All connection procedures must be carried out with the cabinet de-energized.
All work on the units must be carried out by trained personnel only.
Death, serious injury, or substantial material damage can result if these warnings are not taken into account.

Work on an open device must be carried out with extreme caution because external supply voltages may be present. The power and control terminals may be live even when the motor is not running.
Dangerously high voltage levels are still present in the cabinet up to five minutes after it has been disconnected due to the DC link capacitors. For this reason, the cabinet should not be opened until after a reasonable period of time has elapsed.

Reforming the DC link capacitors:
The storage period should not exceed two years. If the device is stored for more than two years, the DC link capacitors of the devices must be reformed during commissioning.
The reforming procedure is described in "Maintenance and Servicing”.

The operator is responsible for ensuring that the motor, converter, and other devices are installed and connected in accordance with the recognized technical rules in the country of installation and applicable regional guidelines. Special attention should be paid to cable dimensioning, fuses, grounding, shutdown, disconnection, and overcurrent protection.

If an item of protective gear trips in a branch circuit, a leakage current may have been disconnected. To reduce the risk of fire or an electric shock, the current-carrying parts and other components in the cabinet unit should be inspected and damaged parts replaced. When an item of protective gear trips, the cause of the trip must be identified and rectified.

NOTE

The standard cabinet units are equipped with shock-hazard protection to BGV A 2 (formerly VBG 4) in accordance with DIN 57 106, Part 100 / VDE 0106, Part 100.

The version with option M60 features additional protective covers that offer a higher level of shock-hazard protection for current-carrying parts when the cabinet doors are open.
These protective covers may have to be removed during installation and connection procedures. Once work has been completed, the protective covers must be properly refitted.

4.4 Introduction to EMC

Electromagnetic compatibility (EMC) describes the capability of an electrical device to function satisfactorily in an electromagnetic environment without itself causing interference unacceptable for other devices in the environment.

EMC, therefore, represents a quality standard for the following:

- Internal noise immunity: resistance against internal electrical disturbances
- External noise immunity: resistance against external electromagnetic disturbances
- Noise emission level: environmental effects caused by electromagnetic emissions

To ensure that the cabinet unit functions satisfactorily in the system, the environment subject to interference must not be neglected. For this reason, special requirements exist regarding the structure and the EMC of the system.

Operational Reliability and Noise Immunity

Measures must be taken by the converter manufacturer and the operator to ensure the greatest possible level of operational reliability and noise immunity within the entire system (converters, automation systems, drive motors, and so on). Only when all of these measures have been taken are the satisfactory function of the converter and compliance with the legal requirements (89/336/EEC) ensured.

Noise Emissions

Product standard EN 61800 – 3 outlines the EMC requirements for variable-speed drive systems. It specifies requirements for converters with operating voltages of less than 1000 V. Different environments and categories are defined depending on where the drive system is installed.

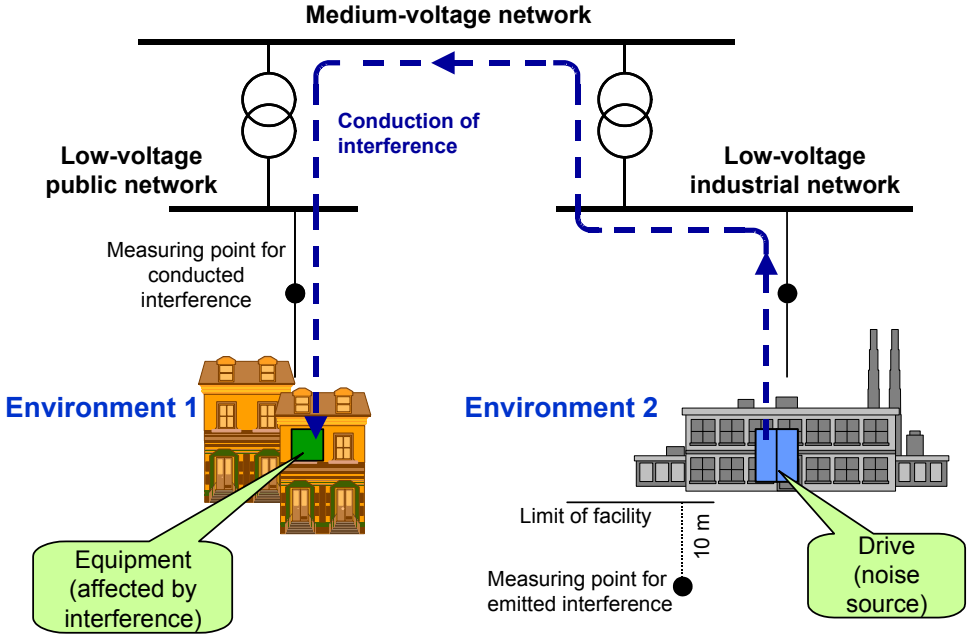


Fig. 4-1 Definition of environments 1 and 2

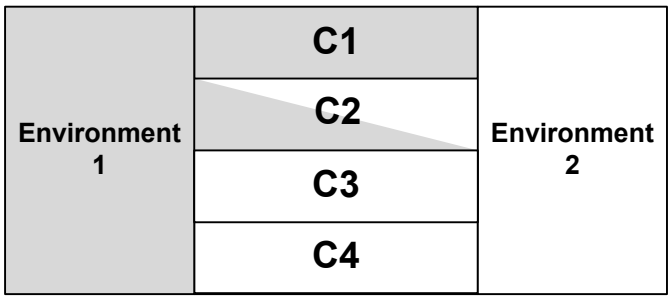


Fig. 4-2 Definition of categories C1 to C4

Definition of environments 1 and 2

- Environment 1:
  Residential buildings or locations at which the drive system is connected to a public low-voltage supply without a transformer.
- Environment 2:
  Industrial locations supplied by a medium-voltage network via a separate transformer.

Definition of categories C1 to C4

- Category C1:
  Rated voltage <1000 V; unrestricted use in environment 1
- Category C2:
  Rated voltage for stationary drive systems <1000 V; for use in environment 2
  For use in environment 1 only when sold and installed by skilled personnel.
- Category C3:
  Rated voltage <1000 V; use in environment 2 only
- Category C4:
  Rated voltage ≥1000 V or for rated currents ≥400 A in complex systems in environment 2

4.5 EMC-Compliant Installation

The following section provides some basic information and guidelines that will help you comply with the EMC and CE guidelines.

Cabinet Assembly

- Connect painted or anodized metal components using toothed self-locking screws or remove the insulating layer.
- Use unpainted, de-oiled mounting plates.
- Establish a central connection between ground and the protective conductor system (ground).

Shield Gaps

- Bridge shield gaps (at terminals, circuit-breakers, contactors, and so on) with minimum impedance and the greatest possible surface area.

Using Large Cross-Sections

- Use underground and grounding cables with large cross-sections or, better still, with litz wires or flexible cables.

Laying the Motor Supply Cable Separately

- The distance between the motor supply cable and signal cable should be > 20 cm. Do not lay power cables and motor supply cables in parallel to each other.

Securing the Potential to Ground Between Modules with Widely Differing Interference Potential

- Lay an equalizing cable parallel to the control cable (the cable cross-section must be at least 16 mm²).
- If relays, contactors, and inductive or capacitive loads are connected, the switching relays or contactors must be provided with anti-interference elements.

Cable Installation

- Cables that are subject to or sensitive to interference should be laid as far apart from each other as possible.
- Noise immunity increases when the cables are laid close to the ground potential. For this reason, you are advised to lay these cables in corners and on the ground potential.
- Ground the spare cables on at least one end.
- Long cables should be shortened or laid in noise resistant areas to avoid additional connecting points.

- Conductors or cables that carry signals of different classes must cross at right angles, especially if they carry sensitive signals that are subject to interference.
  - Class 1:
    unshielded cables for ≤ 60 V DC
    unshielded cables for ≤ 25 V AC
    shielded analog signal cables
    shielded bus and data cables
    operator panel interface, incremental/absolute encoder lines
  - Class 2:
    unshielded cables for > 60 V DC and ≤ 230 V DC
    unshielded cables for > 25 V AC and ≤ 230 V AC
  - Class 3:
    unshielded cables for > 230 V AC/DC and ≤ 1000 V AC/DC

Shield Connection

- Shields must not be used to conduct electricity. In other words, they must not simultaneously act as neutral or PE conductors.
- Apply the shield so that it covers the greatest possible surface area. You can use ground clamps, ground terminals, or ground screw connections.
- Avoid extending the shield to the grounding point using a wire (pigtail) because this will reduce the effectiveness of the shield by up to 90%.
- Attach the shield to a shield bar directly after the line inlet into the cabinet. Insulate the entire shielded cable and route the shield up to the device connection, but do not connect it again.

I/O Connection

- Create a low-impedance ground connection for additional cabinets, system components, and distributed devices with the largest possible cross-section (at least 16 mm²).
- Ground unused lines at one end in the cabinet.
- Choose the greatest possible clearance between the power and signal cables (at least 20 cm). The greater the distance over which the cables are routed in parallel, the greater the clearance must be. If a sufficient clearance cannot be maintained, you must install additional shields.
- Avoid unnecessarily long cable loops.

Filtering Cables

- Line supply cables and power supply cables for devices and modules may have to be filtered in the cabinet to reduce incoming or outgoing disturbances.
- To reduce emissions, SINAMICS G150 is equipped with a radio interference suppression filter as standard (in accordance with the limit values defined in category C3). Optional filters, which are available on request, can be fitted for use in environment 1 (category C2).

4.6 Electrically connecting separately shipped transport units

After the mechanical installation has been completed, for transport units that are separately shipped, the following electrical connections must be established between the righthand and lefthand sub-cabinets:

- The PE buses must be connected
- The DC link must be connected
- The 24 V DC, 230 V AC power supply and signal cables must be connected
- The DRIVE-CLiQ topology must be connected

4.6.1 Connecting the PE buses

A connector jumper is provided loose to connect the PE buses of the two sub-cabinets.

Establishing the connection

1. At the righthand side of the left sub-cabinet release 1 x M12 nut of the PE rail, remove the nut, washer and screw.
2. At the lefthand side of the right sub-cabinet release 1 x M12 nut of the PE rail, remove the nut, washer and screw.
3. Locate the connecting jumper at the PE rails of the sub-cabinets to be connected.
4. Insert the bolts from the front into the grounding lugs of the PE buses.
5. Re-locate the washers and nuts.
6. Tighten the nuts (tightening torque: 50 Nm).

4.6.2 Connecting the DC link connections

Pre-fabricated cables are used to connect the DC link connections of the two sub-cabinets.

WARNING

Under no circumstances may the connections be interchanged or short-circuited!

The cabinet unit will be destroyed if the DC link connections are either interchanged or short-circuited!

Establishing the connection

1. Establish the connection (Cable number –W001) from connection DCPS (cabinet field +H.A49) to the disconnect switch –Q98 (cabinet field +H.A25).
2. Establish the connection (Cable number –W002) from connection DCNS (cabinet field +H.A49) to the disconnect switch –Q99 (cabinet field +H.A25).

4.6.3 Connecting-up the power supply and the signal cables

The connecting cables for 24 V DC and 230 V AC to supply the lefthand sub-cabinet with power and for the signal cables must be connected. This involves 3 connecting cables that must be connected starting from the righthand sub-cabinet (cabinet field +H.A25) to the lower connector sections in the lefthand sub-cabinet (cabinet field +H.A24):

1. Connecting cable with the connector designation –A1–X97 in the lower connector section -A1–X97.
2. Connecting cable with the connector designation –A1–X98 in the lower connector section -A1–X98.
3. Connecting cable with the connector designation –A1–X99 in the lower connector section -A1–X99.

The cables must be routed so that power cables cannot interfere with data and signals that are being transferred along the connecting cables.

4.6.4 Connecting-up the DRIVE-CLiQ topology

The DRIVE-CLiQ connection from the Power Module in the lefthand sub-cabinet (cabinet field +H.A49) to the Control Unit CU320 (cabinet field +H.A50).

The connecting cable (cable number –W003) is inserted in the Power Module in the plant and must be inserted in the DRIVE-CLiQ socket –X102 of the Control Unit. The cables must be routed so that power cables cannot cause interference on the DRIVE-CLiQ connection.

4.7 Power Connections

WARNING

- Swapping the input and output terminals can destroy the cabinet unit!
- Swapping or short-circuiting the DC link terminals can destroy the cabinet unit!
- The contactor and relay operating coils that are connected to the same supply network as the cabinet unit or are located near the cabinet unit must be connected to overvoltage limiters (e.g. RC elements).
- The cabinet unit must not be operated via a residual current operated device (DIN VDE 0160).

4.7.1 Connection Cross-Sections, Cable Lengths

Connection Cross-Sections

The connection cross-sections for the input power connection, motor connection, and cabinet grounding for your cabinet unit are specified in the tables provided in the "Technical Data" section.

Cable Lengths

The maximum connectable cable lengths are specified for standard cable types or cable types recommended by SIEMENS. Longer cables can only be used after consultation.

The specified cable length represents the actual distance between the cabinet unit and the motor, taking into account parallel routing, current-carrying capacity, and the cable-laying factor.

- Unshielded cable (e.g. Protodur NYY): max. 450 m
- Shielded cable (e.g. Protodur NYCWY, Protoflex EMV 3 Plus): max. 300 m

NOTE

The PROTOFLEX-EMV-3 PLUS shielded cable recommended by Siemens is the protective conductor and comprises three symmetrically arranged protective conductors. The individual protective conductors must each be provided with cable eyes and be connected to ground. The cable also has a concentric flexible braided copper shield. To comply with EN55011 regarding radio interference suppression, the shield must contact at both ends and with the greatest possible surface area.

On the motor side, cable glands that contact the shield with the greatest possible surface area are recommended for the terminal boxes.

Minimum motor cable lengths for a 12-pulse infeed and connected to a motor with a one-winding system

For a 12-pulse infeed and connected to a motor with a one-winding system, for the subsequent cabinet units, it must be ensured that the motor cable lengths are kept to a minimum if a motor reactor (option L08) is not being used.

Table 4-1 Minimum cable lengths

Order No.	Power [kW]	Minimum cable length [m]
3-ph. 380 V – 480 V AC		
6SL3710-2GE41-1AA0	630	30
6SL3710-2GE41-4AA0	710	25
6SL3710-2GE41-6AA0	900	20
3-ph. 500 V – 600 V AC		
6SL3710-2GF38-6AA0	630	30
6SL3710-2GF41-1AA0	710	25
6SL3710-2GF41-4AA0	1000	20
3-ph. 660 V – 690 V AC		
6SL3710-2GH41-1AA0	1000	25
6SL3710-2GH41-4AA0	1350	20
6SL3710-2GH41-5AA0	1500	20

4.7.2 Opening and closing the disconnect switch

The following cabinet units are equipped with disconnect switches (–Q98 and –Q99) in cabinet field +H.A25; these disconnect switches can be used to establish or interrupt the connection between the DC links of the sub-cabinets connected in parallel:

- for 3-ph. 380 V – 480 V AC:
  6SL3710-2GE41-1AA0, 6SL3710-2GE41-4AA0, 6SL3710-2GE41-6AA0
- for 3-ph. 500 V – 600 V AC:
  6SL3710-2GF38-6AA0, 6SL3710-2GF41-1AA0, 6SL3710-2GF41-4AA0
- for 3-ph. 660 V – 690 V AC:
  6SL3710-2GH41-1AA0, 6SL3710-2GH41-4AA0, 6SL3710-2GH41-5AA0

WARNING

Please ensure that the two disconnect switches –Q98 and –Q99 are opened and closed together according to the subsequent specifications. The cabinet unit can be damaged if the disconnect switches are incorrectly set.

6-pulse infeed -> open the disconnect switch

For 6-pulse infeeds, disconnect switches –Q98 and –Q99 must be opened and it is not permissible that the DC links are connected with one another; this is the condition with the equipped is shipped.

12-pulse infeed -> close the disconnect switches

For 12-pulse infeeds, the disconnect switches –Q98 and –Q99 must be closed; the DC links must be connected with one another.

4.7.3 Connecting the Motor and Power Cables

Connecting the Motor and Power Cables on the Cabinet Unit

NOTE

The location of the connections is indicated in the layout diagrams provided in 3.

1. Open the cabinet, remove the covers (if necessary) in front of the connection panel for motor cables (terminals U2/T1, V2/T2, W2/T3; X2) and power cables (terminals U1/L1, V1/L2, W1/L3; X1).
2. Move or remove the bottom plate below the connection panel through which the motor cables are fed.
3. Screw the protective earth (PE) into the appropriate terminal (with earth symbol) (50 Nm with M12) at the points provided in the cabinet.

NOTE

With version C, connect the power cables first and then the motor cables.

4. Screw the motor cables onto the terminals.
   Make sure that you connect the conductors in the correct sequence: U2/T1, V2/T2, W2/T3 and U1/L1, V1/L2, W1/L3.

CAUTION

Tighten the screws with the appropriate torque (50 Nm with M12), otherwise the terminal contacts could catch fire during operation.

NOTE

The motor ground must be fed back directly to the cabinet unit and connected.

Direction of Motor Rotation

With induction machines with a clockwise phase sequence (looking at the drive shaft), the motor must be connected to the cabinet unit as follows.

Table 4-2 Connection terminals on the cabinet unit and motor

Cabinet unit (connection terminals)	Motor (connection terminals)
U2/T1	V
V2/T2	V
W2/T3	W

In contrast to the connection for the clockwise phase sequence, two phases have to be reversed with a counter-clockwise phase sequence (looking at the drive shaft).

NOTE

If an incorrect phase sequence was connected when the cables were routed, and the phase sequence cannot be corrected by subsequently swapping the motor cables, it can be corrected by means of a negative command value or by parameterizing the cabinet unit.

With motors that can be operated in a star/delta configuration, the windings must be checked to ensure that they have been connected properly. Please refer to the relevant documentation for the motor and note the required insulation voltage for operating the cabinet unit.

4.7.4 Adjusting the Fan Voltage (-U1-T10)

The power supply for the device fan in the Power Module (-U1-T10) is generated from the main supply system by means of a transformer.
The location of the transformer is indicated in the layout diagrams supplied.
The transformer is fitted with primary taps so that it can be fine-tuned to the rated line supply voltage. When delivered, the taps are always set to the highest level. With a low supply voltage, the appropriate transformer tap must be activated.

NOTE

Two transformers (-U1 –T10 and -T20) are installed in the following cabinet units. The two primary terminals on these devices must be set together.

- for 3-ph. 380 V – 480 V AC: 6SL3710-2GE41-0_A0
- for 3-ph. 500 V – 600 V AC: 6SL3710-2GF37-4_A0, 6SL3710-2GF38-1_A0
- for 3-ph. 660 V – 690 V AC: 6SL3710-2GH37-4_A0, 6SL3710-2GH38-1_A0

NOTE

For the following cabinet units, the setting terminals must be set the same in both sub-cabinets:

- for 3-ph. 380 V – 480 V AC:
  6SL3710-2GE41-1AA0, 6SL3710-2GE41-4AA0, 6SL3710-2GE41-6AA0
- for 3-ph. 500 V – 600 V AC:
  6SL3710-2GF38-6AA0, 6SL3710-2GF41-1AA0, 6SL3710-2GF41-4AA0
- for 3-ph. 660 V – 690 V AC:
  6SL3710-2GH41-1AA0, 6SL3710-2GH41-4AA0, 6SL3710-2GH41-5AA0

The terminals on the setting terminals must be connected to "0" and the supply voltage.

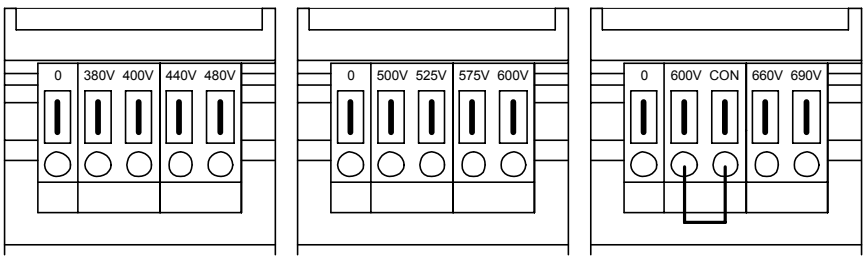


Fig. 4-3 Setting terminals for the fan transformer
(380 V – 480 V 3AC / 500 V – 600 V 3AC / 660 V – 690 V 3AC)

The line supply voltage assignments for making the appropriate setting on the fan transformer are indicated in Table 4-3 to Table 4-5.

NOTE

With the 660 V – 690 V 3AC fan transformer, a jumper is inserted between terminal “600 V” and terminal “CON”. Terminals "600V" and "CON" are for internal use.

IMPORTANT

If the terminals are not reconnected to the actual supply voltage:

- The required cooling capacity cannot be provided because the fan rotates too slowly
- The fan fuses may blow due to an overcurrent.

NOTE

The order numbers for fan fuses that have blown can be found in the spare parts list.

Table 4-3 Supply voltage assignments for setting the fan transformer (380 V – 480 V 3AC)

Line voltage	Fan transformer tap (-U1 -T10)
380 V ± 10 %	380 V
400 V ± 10 %	400 V
440 V ± 10 %	440 V
480 V ± 10 %	480 V

Table 4-4 Supply voltage assignments for setting the fan transformer (500 V – 600 V 3AC)

Line voltage	Fan transformer tap (-U1 -T10)
500 V ± 10 %	500 V
525 V ± 10 %	525 V
575 V ± 10 %	575 V
600 V ± 10 %	600 V

Table 4-5 Supply voltage assignments for setting the fan transformer (660 V – 690 V 3AC)

Line voltage	Fan transformer tap (-U1 -T10)
660 V ± 10 %	660 V
690 V ± 10 %	690 V

4.7.5 Adjusting the Internal Power Supply (-A1 -T10, Version A Only)

A transformer (-A1-T10) is installed for the internal 230 V AC power supply for the cabinet. The location of the transformer is indicated in the layout diagrams supplied.

The primary terminals of the transformer may need to be reconnected to the existing supply voltage.

The supply voltage assignments for making the appropriate setting on the transformer for the internal power supply are indicated in Table 4-6 to Table 4-8.

IMPORTANT

If the terminals are not reconnected to the actual supply voltage, the internal power supply will not be correct.

Table 4-6 Supply voltage assignments for the internal power supply (380 V – 480 V 3AC)

Supply voltage range	Tapping	Matching transformer taps (A1 -T10) LH1 – LH2
342 V – 390 V	380 V	1 - 2
391 V – 410 V	400 V	1 – 3
411 V – 430 V	415 V	1 – 4
431 V – 450 V	440 V	1 – 5
451 V – 470 V	460 V	1 – 6
471 V – 528 V	480 V	1 – 7

Table 4-7 Supply voltage assignments for the internal power supply (500 V – 600 V 3AC)

Supply voltage range	Tapping	Matching transformer taps (A1 -T10) LH1 – LH2
450 V – 515 V	500 V	1 – 8
516 V – 540 V	525 V	1 – 9
541 V – 560 V	550 V	1 – 10
561 V – 590 V	575 V	1 – 11
591 V – 660 V	600 V	1 – 12

Table 4-8 Supply voltage assignments for the internal power supply (660 V – 690 V 3AC)

Supply voltage range	Tapping	Matching transformer taps (A1 -T10) LH1 – LH2
591 V – 630 V	600 V	1 – 12
631 V – 680 V	660 V	1 – 14, terminals 12 and 13 are bridged
681 V – 759 V	690 V	1 – 15, terminals 12 and 13 are bridged

4.7.6 Removing the Connection Bracket for the Interference-Suppression Capacitor with Operation from an Ungrounded Supply

If the cabinet unit is operated from an ungrounded supply/IT supply, the connection bracket for the interference-suppression capacitor of the converter (-U1) must be removed.

Unscrew the screws M4 (Torx T20) and remove the connection bracket.

Fig. 4-4 Removing the connection bracket for the interference-suppression capacitor

NOTE

For the following cabinet units, the connecting jumper must be removed in both sub-cabinets:

- for 3-ph. 380 V – 480 V AC:
  6SL3710-2GE41-1AA0, 6SL3710-2GE41-4AA0, 6SL3710-2GE41-6AA0
- for 3-ph. 500 V – 600 V AC:
  6SL3710-2GF38-6AA0, 6SL3710-2GF41-1AA0, 6SL3710-2GF41-4AA0
- for 3-ph. 660 V – 690 V AC:
  6SL3710-2GH41-1AA0, 6SL3710-2GH41-4AA0, 6SL3710-2GH41-5AA0

4.8 External Supply of the Auxiliary Supply from a Secure Line

Description

An external auxiliary supply is always recommended if communication and closed-loop control are to be independent of the supply system. An external auxiliary supply is particularly recommended for low-power lines susceptible to short-time voltage dips or power failures.

With an external supply independent of the main supply, warnings and fault messages may still be displayed on the operator panel and internal protection and monitoring devices if the main supply fails.

DANGER

When the external auxiliary supply is connected, dangerous voltages are present in the cabinet unit even when the main circuit-breaker is open.

NOTICE

An external auxiliary supply (infeed) must always be used if the automatic restart (WEA) function is to be used with integrated EMERGENCY STOP option (L57, L59, L60).
Otherwise, the automatic restart function does not work.

Table 4-9 Connection options for the external auxiliary voltage depending on the selected options.

Cabinet unit option	External supply of auxiliary voltage independent of the main supply			
	24 V DC terminal –X9	230 V AC terminal –X40	24 V DC (terminal –X9) 230 V AC (terminal –X40) *1)	230 V AC (terminal –X40) with options L13 / L26 (when I > 800 A)
-With no further options -Version C	X			
L13		X		
L26 (when I > 800 A)		X		
L83			X	X
L84			X	X
L86			X	X
L87			X	X

*1) This is required when not only the open and closed-loop control but also the 230 V AC consumer (thermistor motor protection, PT100 evaluation unit, or insulation monitor) is to remain in operation if the main supply fails.

4.8.1 230 V AC Auxiliary Supply

The maximum fuse rating is 16 A.

The connection is protected inside the cabinet with 3 A or 5 A.

Connection

- On terminal block -X40, remove the jumpers between terminals 1 and 2 as well as 5 and 6.
- Connect the external 230 V AC supply to terminals 2 (L1) and 6 (N).

4.8.2 24 V DC Auxiliary Supply

The power requirement is 5 A.

Connection

Connect the external 24 V DC supply to terminals 1 (P 24 V) and 2 (M_{ext}) of terminal block –X9.

4.9 Signal Connections

4.9.1 Customer Terminal Block (-A60)

NOTE

The factory setting and description of the customer terminal block can be found in the circuit diagrams.

The location of the customer terminal block in the cabinet unit is indicated in the layout diagram.

Shield Connection

The shield connection of shielded control cables on the customer terminal block –A60 is established in the immediate vicinity of the terminal block. For this purpose, the customer terminal block –A60 and the mounting plates have cut-out sections which are used to snap the enclosed shield springs into place. The shields of incoming and outgoing cables must be applied directly to these shield connections. It is important here to establish the greatest possible area of contact and a good conductive connection.

NOTE

These shield springs can be used for all control cables in the cabinet unit because all the shield connections are identical in design.

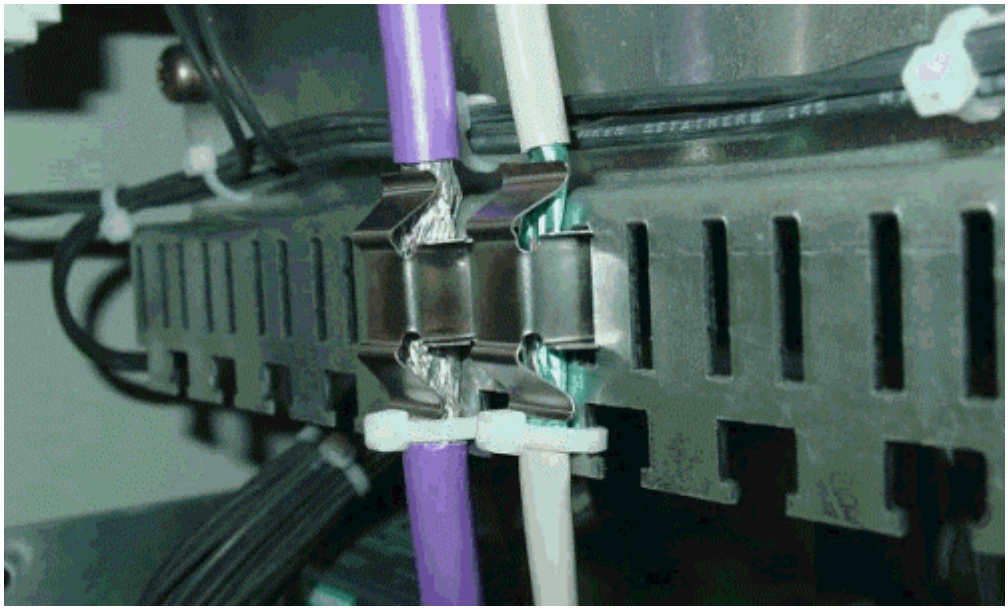


Fig. 4-5 Shield connection

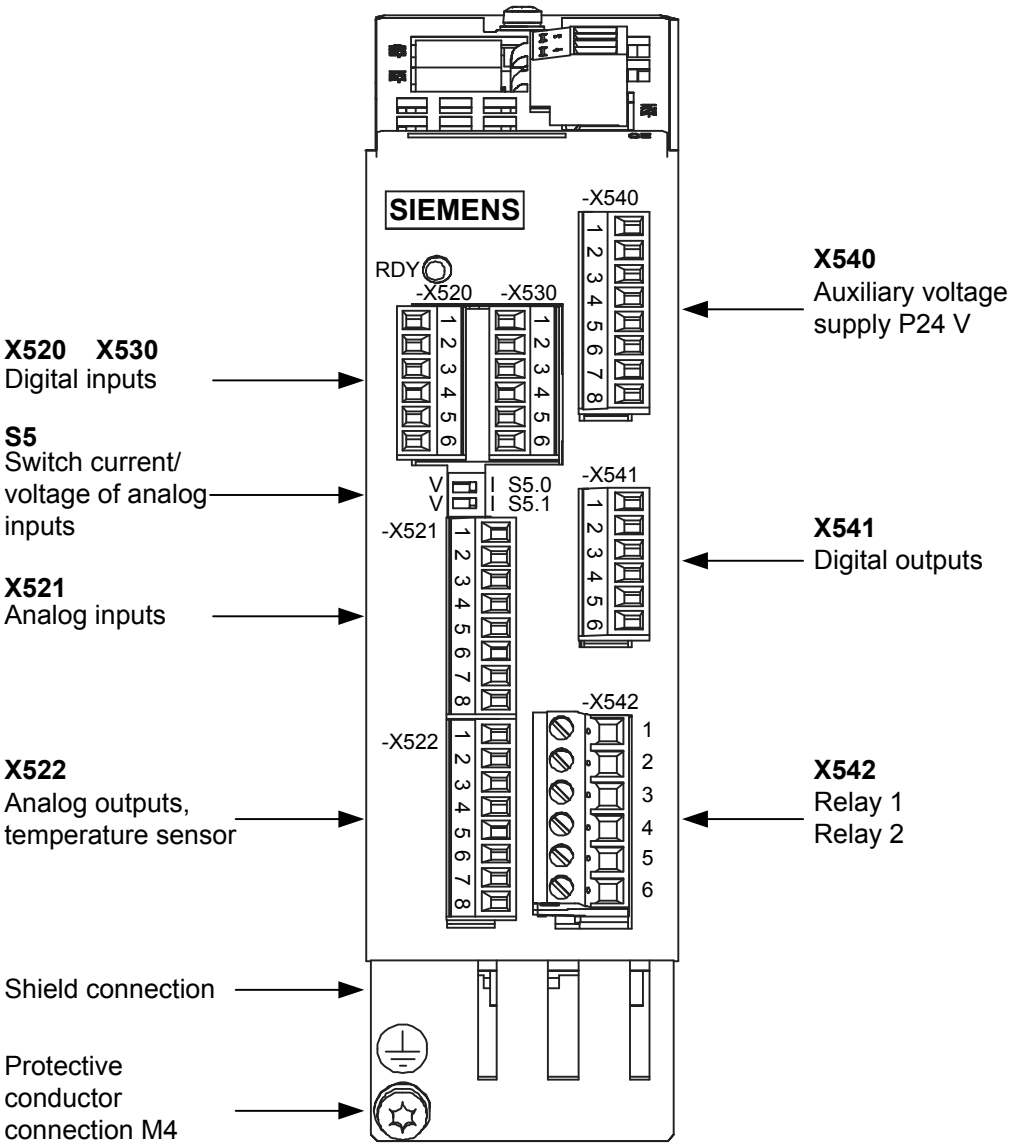


Fig. 4-6 Customer terminal block TM31

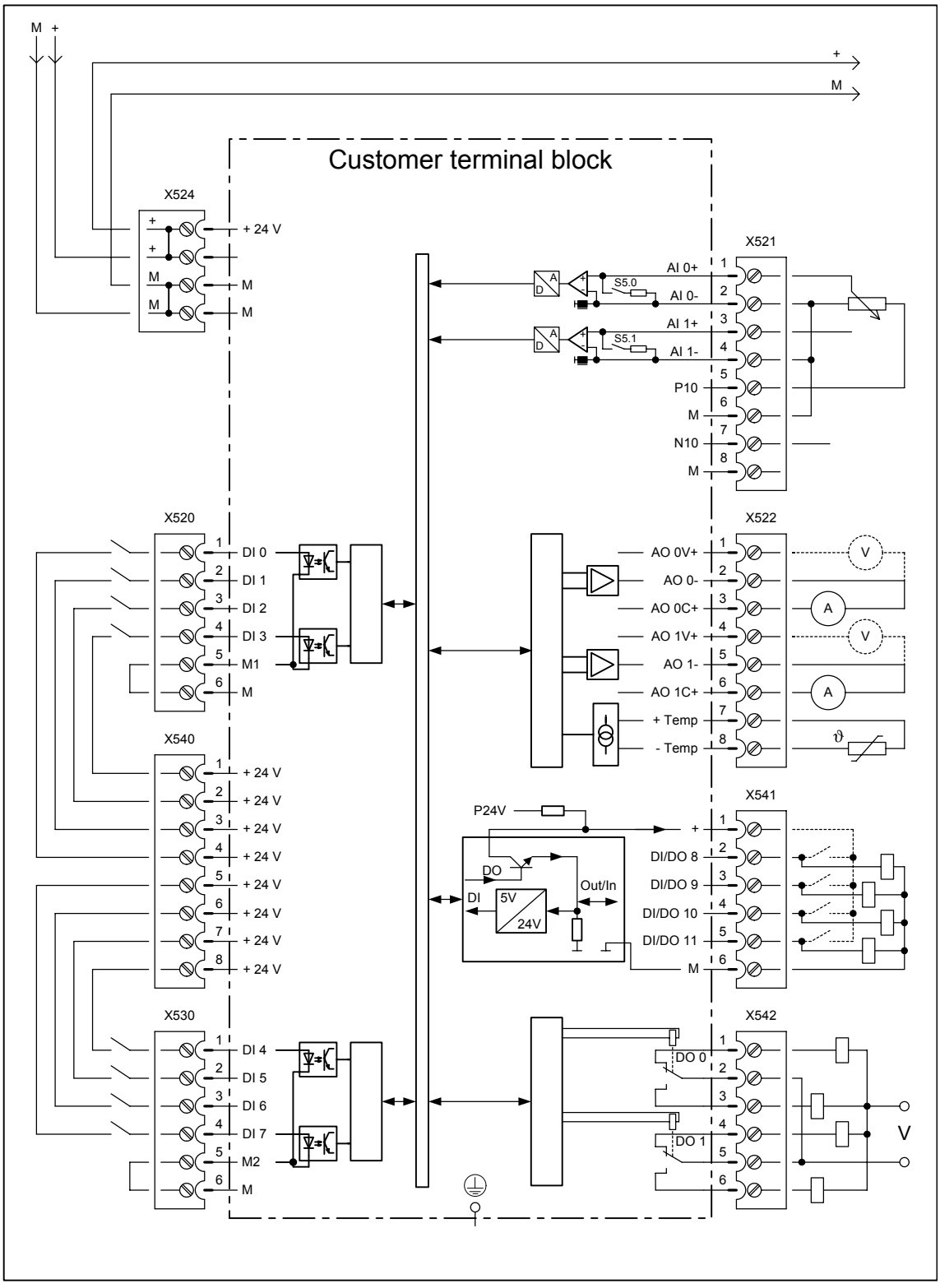


Fig. 4-7 Connection overview for customer terminal block TM31

NOTE

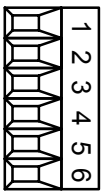
The digital inputs (terminals -X520 and -X530) in the example are powered by the internal 24 V supply of the customer terminal block (terminal -X540).

The two groups of digital inputs (optocoupler inputs) have a common reference potential (ground reference M1 or M2). In order to close the circuit when the internal 24 V supply is used, the ground references M1 / M2 must be connected to internal ground (M).

If power is not supplied from the internal 24 V supply (terminal -X540), the jumper between ground M1 and M or M2 and M must be removed in order to avoid potential rounding. The external ground must then be connected to terminals M1 and M2.

X520: 4 Digital Inputs

Table 4-10 Terminal block X520

	Terminal	Designation [1]	Technical specifications
	1	DI 0	Voltage: -3 V to 30 V
	2	DI 1	Current input (typical): 10 mA at 24 V
	3	DI 2	With electrical isolation: reference potential is terminal M1
	4	DI 3	Level: High signal level: 15 V to 30 V Low signal level: -3 V to 5 V
	5	M1	
	6	M	

[1] DI: digital input; M1: ground reference; M: electronic ground

Max. connectable cross-section: 1.5 mm² (AWG 14)

NOTE

An open input is interpreted as "low".

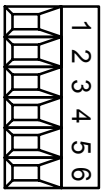
To enable the digital inputs to function, terminal M1 must be connected. This can be done as follows:

1) The provided ground reference of the digital inputs, or

2) A jumper to terminal M (note: this removes isolation for these digital inputs).

X530: 4 Digital Inputs

Table 4-11 Terminal block X530

	Terminal	Designation [1]	Technical specifications
	1	DI 4	Voltage: -3 V to 30 V
	2	DI 5	Current input (typical): 10 mA at 24 V
	3	DI 6	With electrical isolation: The reference potential is terminal M2
	4	DI 7	Level:
	5	M2	High signal level: 15 V to 30 V
	6	M	Low signal level: -3 V to 5 V

[1] DI: digital input; M2: ground reference; M: Electronic ground

Max. connectable cross-section: 1.5 mm² (AWG 14)

NOTE

An open input is interpreted as "low".

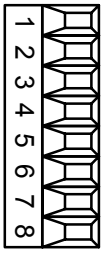
To enable the digital inputs to function, terminal M1 must be connected. This can be done as follows:

1) The provided ground reference of the digital inputs, or

2) A jumper to terminal M (note: this removes isolation for these digital inputs).

X521: 2 Analog Inputs (Differential Inputs)

Table 4-12 Terminal block X521

	Terminal	Designation [1]	Technical specifications
	1	AI 0+	-10 V - +10 V, R_i = 70 kΩ +4 mA - +20 mA -20 mA - +20 mA, R_i = 250 Ω 0 mA - +20 mA (factory setting)
	2	AI 0-	
	3	AI 1+	
	4	AI 1-	
	5	P10	+10 V ± 1 %, I_{max} 5 mA
	6	M	Reference potential for AI 0
	7	N10	-10 V ± 1 %, I_{max} 5 mA
	8	M	Reference potential for AI 1

[1] AI: analog input; P10/N10: auxiliary voltage, M: Ground reference

Max. connectable cross-section: 1.5 mm² (AWG 14)

CAUTION

The input current of the analog inputs must not exceed 35 mA when current measurements are performed.

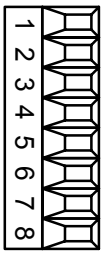
S5: Selector for Voltage/Current AI0, AI1

Table 4-13 Selector for voltage/current S5

Switch	Function	Technical specifications
S5.0	Selector voltage/current AI0	Voltage Current
S5.1	Selector voltage/current AI1	

X522: 2 Analog Outputs, Temperature Sensor Connection

Table 4-14 Terminal block X522

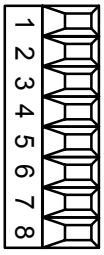
	Terminal	Designation [1]	Technical specifications
	1	AO 0 V+	-10 V - +10 V +4 mA - +20 mA -20 mA - +20 mA 0 mA - +20 mA
	2	AO 0 ref.	
	3	AO 0 A+	
	4	AO 1 V+	
	5	AO 1 ref.	
	6	AO 1 A+	
	7	KTY+	KTY84: 0...200°C PTC: $R_{cold} \leq 1.5\ k\Omega$
	8	KTY-	

[1] AO: analog output; KTY: temperature sensor connection

Max. connectable cross-section: 1.5 mm² (AWG 14)

X540: Common Auxiliary Voltage for Digital Inputs

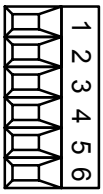
Table 4-15 Terminal block X540

	Terminal	Designation	Technical specifications
	1	P24	VDC Imax = 150 mA (total of all P24 terminals) Continued-short-circuit-proof
	2	P24	
	3	P24	
	4	P24	
	5	P24	
	6	P24	
	7	P24	
	8	P24	

Max. connectable cross-section: 1.5 mm² (AWG 14)

X541: 4 Non-Floating Digital Inputs/Outputs

Table 4-16 Terminal block X541

	Terminal	Designation [1]	Technical specifications
	1	P24	As input:
	2	DI/DO 8	Voltage: -3 V to 30 V
	3	DI/DO 9	Current input (typical): 10 mA at 24 V DC
	4	DI/DO 10	As output:
	5	DI/DO 11	Max. load current per output: 20 mA
	6	M	Continued-short-circuit-proof

[1] DI/DO: digital input/output; M: Electronic ground

Max. connectable cross-section: 1.5 mm² (AWG 14)

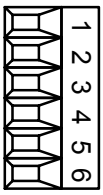
NOTE

An open input is interpreted as "low".

When externally-generated 24 V DC signals are connected, the ground must also be connected.

X542: 2 Relay Outputs (Two-Way Contacts)

Table 4-17 Terminal block X542

	Terminal	Designation [1]	Technical specifications
	1	DO 0.NC	Max. load current: 8 A
	2	DO 0.COM	Max. switching voltage: 250 V AC, 30 V DC
	3	DO 0.NO	
	4	DO 1.NC	Max. switching capacity: at 250 V AC: 2000 VA bei DC 30 V: 240 W (ohmic load)
	5	DO 1.COM	
	6	DO 1.NO	Required minimum load: 20 mA

[1] NO: normally-open contact, NC: normally-closed contact, COM: mid-position contact

Max. connectable cross-section: 2.5 mm² (AWG 12)

NOTE

If 230 V AC is applied to the relay outputs, the customer terminal block must also be grounded via a 6 mm² protective conductor.

4.10 Other Connections

Depending on the options installed, further connections have to be established, for example, sinusoidal filter, main contactor, connection for external auxiliary equipment, main circuit-breaker including fuses or circuit-breaker, EMERGENCY OFF button, cabinet illumination with service socket, anti-condensation heating for cabinet, contactor combination (EMERGENCY OFF), thermistor motor protection unit, PT100 evaluation unit, insulation monitor, encoder evaluator, and NAMUR option.

Detailed information on connecting these options with interfaces can be found in “Additional Operating Instructions” in the documentation folder.

4.10.1 Main Contactor (Option L13)

Description

The SINAMICS G150 cabinet unit is designed as standard without a line contactor. Option L13 (main contactor) is needed if a switching element is required for disconnecting the cabinet from the supply (necessary with EMERGENCY OFF). The contactor is energized and supplied within the cabinet.

Connection

Table 4-18 Terminal block X50 – checkback contact "main contactor closed "

Terminals	Designation [1)]	Technical specifications
4	NO	Max. load current: 10 A
5	NC	Max. switching voltage: 250 V AC
6	COM	Max. switching capacity: 250 VA
		Required minimum load: ≥1 mA

[1)] NO: normally-open contact, NC: normally-closed contact, COM: mid-position contact

Max. connectable cross-section: 4 mm² (AWG 10)

4.10.2 Sinusoidal Filter (Option L15)

Description

The sinusoidal filter limits the voltage gradients and the capacitive charge/discharge currents that normally occur when the converter is in operation. Additional pulse-frequency-dependent noise is also prevented. The service life of the motor is the same as that for direct on-line operation.

CAUTION

If a sinusoidal filter is connected to the converter, the filter must be activated during commissioning to prevent it from being destroyed (see Chapter 5).

Restrictions

The following restrictions must be taken into account when a sinusoidal filter is used:

- The output frequency is limited to max. 115 Hz (at 500 – 600 V) or 150 Hz (at 380 – 480 V).
- The modulation type is permanently set to space vector modulation without overmodulation. This reduces the maximum output voltage to approx. 90% of the rated output voltage.
- Maximum permissible motor cable lengths:
  - Unshielded cable: max. 150 m
  - Shielded cable: max. 100 m

NOTE

If a filter cannot be parameterized (p0230 ≠ 3), this means that a filter has not been provided for the cabinet unit. In this case, the cabinet unit must not be operated with a sinusoidal filter.

Table 4-19 Technical specifications for sinusoidal filters with SINAMICS G150

Order no. SINAMICS G150	Voltage [V]	Pulse frequency [kHz]	Output current [A] [1)]
6SL3710-1GE32-1AA0	3AC 380 – 480	4	172 A
6SL3710-1GE32-6AA0	3AC 380 – 480	4	216 A
6SL3710-1GE33-1AA0	3AC 380 – 480	4	273 A
6SL3710-1GE33-8AA0	3AC 380 – 480	4	331 A
6SL3710-1GE35-0AA0	3AC 380 – 480	4	382 A
6SL3710-1GF31-8AA0	3AC 500 – 600	2.5	152 A
6SL3710-1GF32-2AA0	3AC 500 – 600	2.5	187 A

1) The values refer to operation with a sinusoidal filter and do not correspond to the rated current as specified on the type plate.

Table 4-20 Parameter settings for sinusoidal filters with SINAMICS G150

Parameter	Name	Setting
p0233	Power Module motor reactor	Filter inductance
p0234	Power Module sinusoidal filter capacity	Filter capacity
p0290	Power Module overload response	Disable pulse frequency reduction
p1082	Maximum speed	Fmax filter / number of pole pairs
p1800	Pulse frequency	Nominal pulse frequency of the filter (see Table 4-19)
p1802	Modulator modes	Space vector modulation without overmodulation

NOTE

When the factory setting is applied, parameter p0230 is reset.
If commissioning is carried out again, the parameter must be reset.

4.10.3 Connection for External Auxiliary Equipment (Option L19)

Description

This option includes an outgoing circuit fused at max. 10 A for external auxiliary equipment (e.g. separately-driven fan for motor). The voltage is tapped at the converter input upstream of the main contactor/circuit-breaker and, therefore, has the same level as the supply voltage. The outgoing circuit can be switched within the converter or externally.

Connection

Table 4-21 Terminal block X155 – connection for external auxiliary equipment

Terminal	Designation	Technical specifications
1	L1	3AC 380 – 480 V 3AC 500 – 600 V 3AC 660 – 690 V
2	L2	
3	L3	
11	Contactor control	230 V AC
12		
13	Checkback from circuit-breaker	AC 230 V / 0,5 A DC 24 V / 2 A
14		
15	Checkback from contactor	240 V AC / 6 A
16		
PE	PE	PE

Max. connectable cross-section: 4 mm² (AWG 10)

NOTE

The connection for external auxiliary equipment must be set in accordance with the connected consumer (-Q155).

Circuit Proposal for Controlling the Auxiliary Contactor from Within the Converter

The following circuit, for example, can be used if the auxiliary contactor is to be controlled from within the converter. The “Operation” message is then no longer available for other purposes.

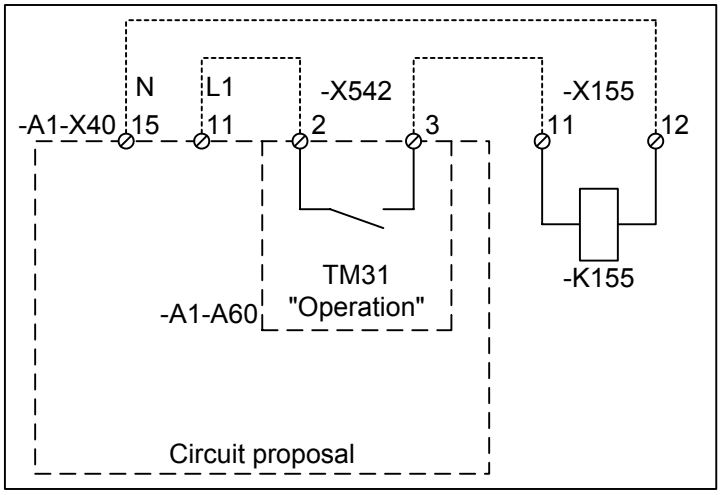


Fig. 4-8 Circuit proposal for controlling the auxiliary conductor from within the converter

NOTE

If 230 V AC is applied to the relay outputs, the customer terminal block must also be grounded via a 6 mm² protective conductor.

4.10.4 Main Circuit-Breaker Incl. Fuses/Circuit-Breaker (Option L26)

Description

Up to 800 A, a load interrupter with externally-mounted fuses is used as the main circuit-breaker. Above 800 A, the standard circuit-breaker is used. The circuit-breaker is energized and supplied within the converter.

Connection

Table 4-22 Terminal block X50 – checkback contact “main circuit-breaker/circuit-breaker closed“

Terminal	Designation [1)]	Technical specifications
1	NO	Max. load current: 10 A
2	NC	Max. switching voltage: 250 V AC
3	COM	Max. switching capacity: 250 VA
		Required minimum load: ≥1 mA

[1)] NO: normally-open contact, NC: normally-closed contact, COM: mid-position contact

Max. connectable cross-section: 4 mm² (AWG 10)

4.10.5 EMERGENCY OFF Button (Option L45)

Description

The EMERGENCY OFF button with protective collar is integrated in the door of the cabinet unit. The contacts of the button are connected to terminal block –X120. Category 0 and 1 EMERGENCY OFF functions can be activated in conjunction with options L57, L59, and L60.

A braking unit may be necessary to achieve the required shutdown times.

NOTE

When the EMERGENCY OFF button is pressed, the motor coasts to a standstill and the main motor voltage is disconnected (to EN 60204-1 (VDE 0113)). Auxiliary voltages (e.g. for separately-driven fans or anti-condensation heating) may still be present. Voltage is also present within certain sections of the converter (e.g. the closed-loop control or any auxiliary equipment). If all the voltages have to be completely disconnected, the EMERGENCY OFF button must be integrated in a protection concept, which must be implemented on the system side. For this purpose, an NC contact is installed at terminal -X120.

Connection

Table 4-23 Terminal block X120 – checkback contact "EMERGENCY OFF button in cabinet door"

Terminal	Designation [1]	Technical specifications
1	NC	Checkback contacts of EMERGENCY OFF button in cabinet door Max. load current: 10 A Max. switching voltage: 250 V AC Max. switching capacity: 250 VA Required minimum load: ≥1 mA
2	NC	
3	NC [2]	
4	NC [2]	

[1] NC: normally-closed contact

[2] Factory setting in converter for options L57, L59, and L60

Max. connectable cross-section: 4 mm² (AWG 10)

4.10.6 Cabinet Illumination with Service Socket (Option L50)

Description

One universal lamp with an integrated service socket is installed for each cabinet panel. The power supply for the cabinet illumination and socket must be provided externally and fused at max. 10 A. The cabinet illumination is switched on manually via a slide switch or automatically by means of an integrated motion detector (factory setting). The mode is selected via the switch on the light.

Connection

Table 4-24 Terminal block X390 – connection for cabinet illumination with service socket

Terminal	Designation	Technical specifications
1	L1	230 V AC
2	N	
3	PE	

Max. connectable cross-section: 4 mm² (AWG 10)

4.10.7 Cabinet Anti-Condensation Heating (Option L55)

Description

The anti-condensation heating is used at low ambient temperatures and high levels of humidity to prevent condensation forming.
A 100-W heater is installed for a 400 mm and 600 mm cabinet panel, and 2 100-W heaters for an 800/1000 and 1200 mm cabinet panel. The power supply for the heating (110 V – 230 V AC) must be provided externally and fused at max. 16 A.

DANGER

When the supply voltage for the cabinet anti-condensation heating is connected, dangerous voltages are present in the cabinet unit even when the main circuit-breaker is open.

Connection

Table 4-25 Terminal block X240 – connection for cabinet anti-condensation heating

Terminal	Designation	Technical specifications
1	L1	110 V -230 V AC
2	N	Power supply
3	PE	Protective earth conductor

Max. connectable cross-section: 4 mm² (AWG 10)

4.10.8 EMERGENCY OFF Category 0; 230 V AC or 24 V DC (Option L57)

Description

EMERGENCY OFF category 0 for uncontrolled stop to EN 60 204. This function involves disconnecting the cabinet from the supply via the line contactor bypassing the electronics by means of a safety combination to EN 60 204-1. The motor then coasts to a stop. To prevent the main contactor from switching under load, an OFF2 is triggered simultaneously. The operational status is indicated by means of three LEDs (-A120).

In the factory setting, this version is set with a 230 V AC button circuit.

NOTE

When the EMERGENCY OFF button is pressed, the motor coasts to a standstill and the main motor voltage is disconnected (to EN 60204-1 (VDE 0113)). Auxiliary voltages (e.g. for separately-driven fans or anti-condensation heating) may still be present. Voltage is also present within certain sections of the converter (e.g. the closed-loop control or any auxiliary equipment). If all the voltages have to be completely disconnected, the EMERGENCY OFF button must be integrated in a protection concept, which must be implemented on the system side. For this purpose, an NC contact is installed at terminal -X120.

Connection

Table 4-26 Terminal X120 – connection for EMERGENCY OFF category 0, 230 V AC and 24 V DC

Terminal	230 V AC and 24 V DC button circuit
7	Loop in EMERGENCY OFF button from system side, remove jumper 7-8
8	
15	"On" for monitored start: Remove bridges 15–16 and connect button.
16	
17	Checkback "trip safety combination"
18	

Max. connectable cross-section: 4 mm² (AWG 10)

Reconnection to the 24 V DC Button Circuit

When using the 24 V DC button circuit, you must remove the following jumpers at terminal X120:

4-5, 9-10, and 11-14

You must also insert the following jumpers at terminal X120:

4-11, 5-10, and 9-14

Diagnostics

Messages output during operation and in the event of faults (meaning of LEDs on –A120) are described in "Additional Operating Instructions" in the operating manual.

4.10.9 EMERGENCY OFF Category 1; 230 V AC (Option L59)

Description

EMERGENCY OFF category 1 for controlled stop to EN 60 204. This function stops the drive by means of a rapid stop using a deceleration ramp that must be parameterized. The cabinet unit is then disconnected from the power supply via the line contactor, which bypasses the electronics by means of a safety combination (to EN 60 204-1). The operating status is indicated by means of eight LEDs (-A120, -A121).

Connection

Table 4-27 Terminal block X120 – connection for EMERGENCY OFF category 1 (230 V AC)

Terminals	Technical specifications
7	Loop in EMERGENCY OFF button from system side, remove jumper 7-8
8	
15	"On" for monitored start: Remove bridges 15–16 and connect button.
16	
17	Checkback "trip safety combination"
18	

Max. connectable cross-section: 4 mm² (AWG 10)

Setting

When the emergency stop function (OFF3 ramp-down time, p1135) is used to shut down the drive, the ramp-down time should be less than (or at the most equal to) the time set on the contactor combination, after which the converter is de-energized.

Diagnostics

Messages output during operation and in the event of faults (meaning of LEDs on -A120, -A121) are described in "Additional Operating Instructions" in the operating manual.

4.10.10 EMERGENCY OFF Category 1; 24 V DC (Option L60)

Description

EMERGENCY OFF category 1 for controlled stop to EN 60 204. This function stops the drive by means of a rapid stop using a deceleration ramp that must be parameterized. The cabinet unit is then disconnected from the power supply via the line contactor, which bypasses the electronics by means of a safety combination (to EN 60 204-1). The operating status is indicated by means of five LEDs (-A121).

Connection

Table 4-28 Terminal block X120 – connection for EMERGENCY OFF category 1 (24 V DC)

Terminals	Button circuit 24 V DC
7	Loop in EMERGENCY OFF button from system side, remove jumper 7-8
8	
15	"On" for monitored start: Remove bridges 15–16 and connect button.
16	
17	Checkback "trip safety combination"
18	

Max. connectable cross-section: 4 mm² (AWG 10)

Setting

When the emergency stop function (OFF3 ramp-down time, p1135) is used to shut down the drive, the ramp-down time should be less than (or at the most equal to) the time set on the contactor combination, after which the converter is de-energized.

Diagnostics

Messages output during operation and in the event of faults (meaning of LEDs on –A120) are described in "Additional Operating Instructions" in the operating manual.

4.10.11 25 kW Braking Unit (Option L61); 50 kW Braking Unit (Option L62)

Description

Braking units are used when regenerative energy occurs occasionally and briefly, for example when the brake is applied to the drive (emergency stop). The braking units comprise a chopper power section and a load resistor, which must be attached externally. To monitor the braking resistance, a thermostat integrated in the shutdown train of the cabinet unit is installed in the braking resistor.

Table 4-29 Load data for the braking units

Line voltage	Cont. chopper power P_{DB}	Peak chopper power P_{15}	Chopper P_{20} power P_{20}	Chopper P_{40} power P_{40}	Braking resistor R_B	Max. current
380 V – 480 V	25 kW	125 kW	100 kW	50 kW	4.4 Ω ± 7.5 %	189 A
380 V – 480 V	50 kW	250 kW	200 kW	100 kW	2.2 Ω ± 7.5 %	378 A
500 V – 600 V	50 kW	250 kW	200 kW	100 kW	3.4 Ω ± 7.5 %	306 A
660 V – 690 V	25 kW	125 kW	100 kW	50 kW	9.8 Ω ± 7.5 %	127 A
660 V – 690 V	50 kW	250 kW	200 kW	100 kW	4.9 Ω ± 7.5 %	255 A

Installing the Braking Resistor

The braking resistor should not be installed in the vicinity of the converter. The following points must be taken into account:

- The braking resistors are only suitable for floor mounting.
- The maximum cable length between the cabinet unit and braking resistor is 50 m.
- Sufficient space must be available for dissipating the energy converted by the braking resistor.
- A sufficient distance from flammable objects must be maintained.
- The braking resistor must installed as a free-standing unit.
- Objects must not be placed on or anywhere above the braking resistor.
- The braking resistor should not be installed underneath fire detection systems.

CAUTION

A ventilation clearance of 200 m must be maintained on all sides of the braking resistor (with ventilation grilles).

Table 4-30 Braking resistor dimensions

	Unit	25 kW resistor (option L61)	50 kW resistor (option L62)
Length	mm	740	810
Width	mm	485	485
Height	mm	605	1325

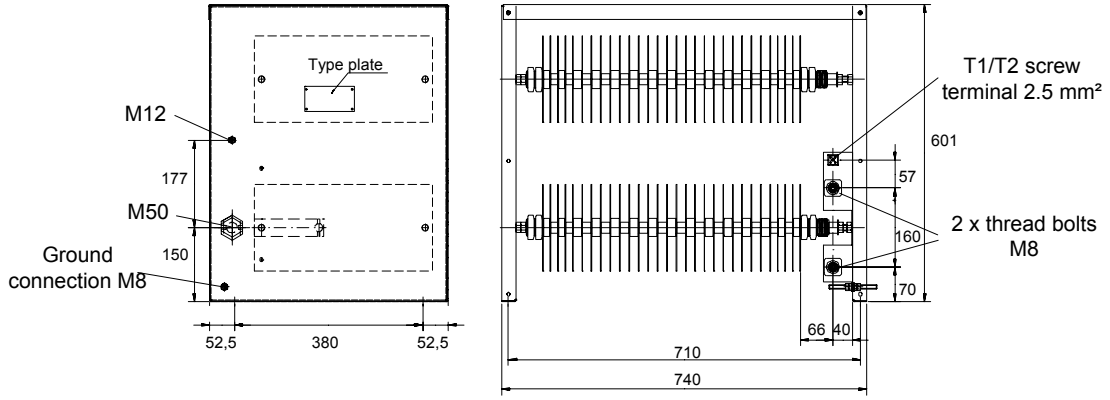


Fig. 4-9 Dimension drawing for braking resistor (25 kW)

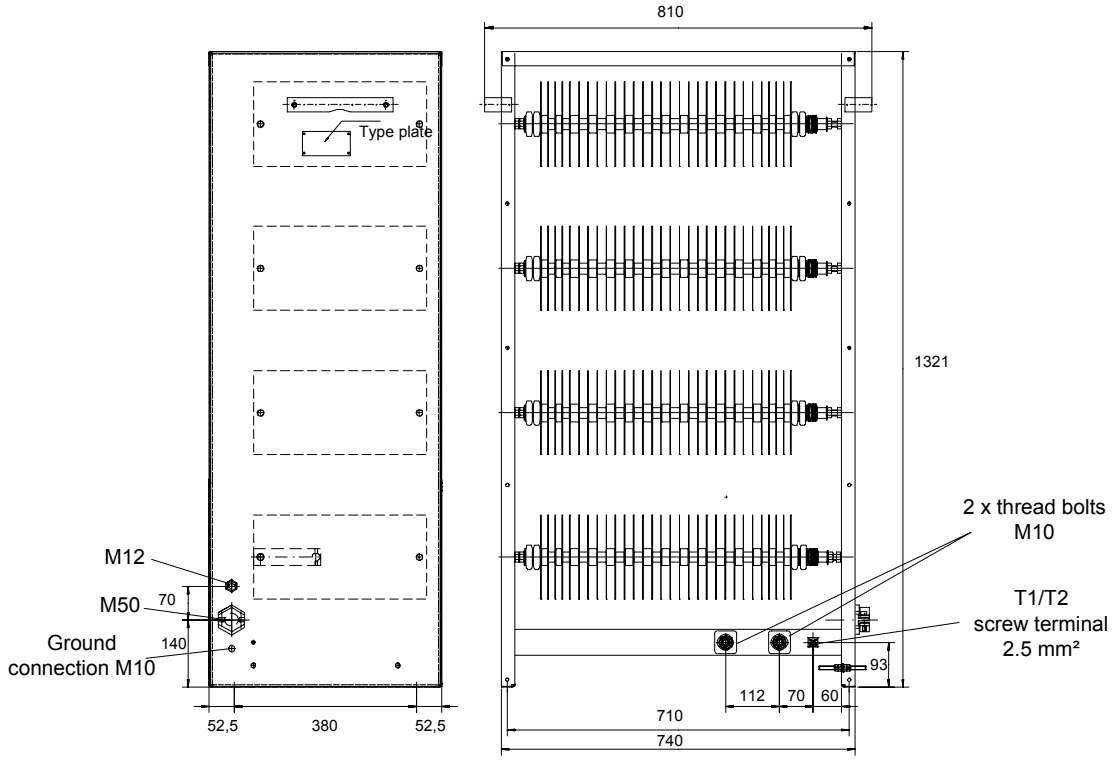


Fig. 4-10 Dimension drawing for braking resistor (50 kW)

Connecting the Braking Resistor

WARNING

The cables must only be connected to terminal block -X5 when the cabinet unit is switched off and the DC link capacitors are discharged.

CAUTION

The braking resistor cables must be laid in such a way that they are short-circuit and ground-fault proof!

The length of the connection cables between the cabinet unit and external braking resistor must not exceed 50 m.

Table 4-31 Terminal block X5 – connection for external braking resistor

Terminal	Functional description
1	Braking resistor connection
2	Braking resistor connection

Max. connectable cross-section: 70 mm² (AWG 000)

Recommended cable cross-sections:

- For L61 (25 kW): 35 mm² (AWG 0)
- For L62 (50 kW): 50 mm² (AWG 00)

Table 4-32 Installing the thermostat for the external braking resistor in the monitoring train of the cabinet unit

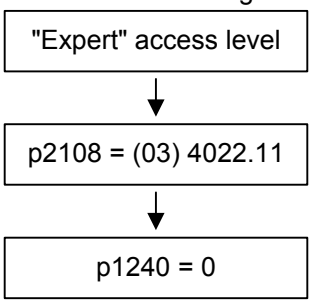
Terminal	Functional description
T1	Thermostat connection: connection with terminal X541:1 (P24 V)
T2	Thermostat connection: connection with terminal X541:5 (DI11)

Max. connectable cross-section: 1.5 mm² (AWG 14)

Cabinet Unit Settings

If the braking resistor thermostat is connected to digital input 11, appropriate settings have to be made so that the drive is brought to a standstill if a fault occurs.

Once the device has been successfully commissioned, you have to make the following changes:



Setting the "Expert" on the operator panel
<Key pushbutton> - <Access level> - Set "Expert" and confirm (enter activation code "47")

Switch external fault 3 to DI 11 on the TM31.

Disabling the Vdc-max controller
When the brake chopper is used, the Vdc-max controller must be switched off.

Fig. 4-11 Activating the connection for "External Fault 3"

Diagnostics

If the thermostat is opened due to a thermal overload on the braking resistor, fault F7862 ("External Fault 3") is triggered and the drive is switched off with OFF2.

The braking chopper is not monitored using the software because it has a self-protection function. It can be monitored using the status bit for digital input 4 (parameter r0721.4):

- r0721.4 = 1: Chopper is functioning properly
- r0721.4 = 0: Chopper is malfunctioning

You can acknowledge malfunctions in the braking unit by pressing the "Acknowledge" button on the operator panel when the DC link voltage is present).

Duty Cycles

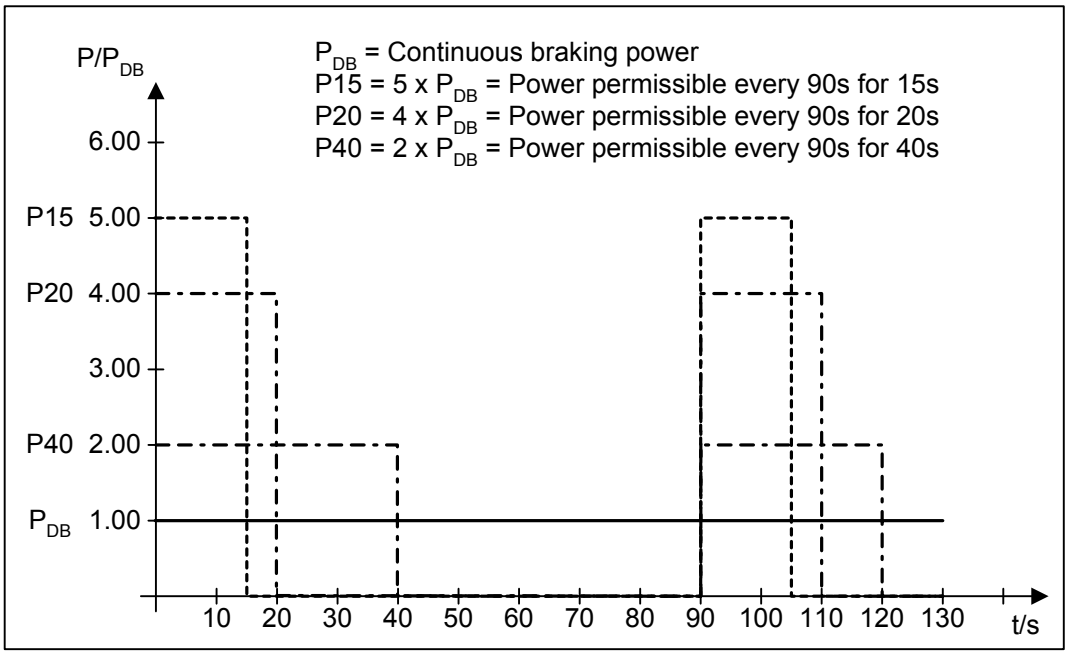

P/P_DB
P_DB = Continuous braking power
P15 = 5 x P_DB = Power permissible every 90s for 15s
P20 = 4 x P_DB = Power permissible every 90s for 20s
P40 = 2 x P_DB = Power permissible every 90s for 40s
6.00
P15 5.00
P20 4.00
3.00
P40 2.00
P_DB 1.00
10 20 30 40 50 60 70 80 90 100 110 120 130
t/s

Fig. 4-12 Duty cycles for the braking resistors

Threshold Switch

The response threshold at which the braking unit is activated and the DC link voltage generated during braking are specified in the following table.

WARNING

The threshold switch must only be used when the cabinet unit is switched off and the DC link capacitors are discharged.

Table 4-33 Response thresholds for the braking units

Nominal voltage	Response threshold	Switch position	Comments
380 V – 480 V	774 V	1	774 V is the default factory setting. With supply voltages of between 380 V and 400 V, the response threshold can be set to 673 V to reduce the voltage stress on the motor and converter. This does, however, reduce the possible peak power (P_{15}) with the square of the voltage $(673/774)^2 = 0.75$. The possible peak power is, therefore, max. 75 % of P_{15}.
	673 V	2	
500 V – 600 V	967 V	1	967 V is the default factory setting. With a supply voltage of 500 V, the response threshold can be set to 841 V to reduce the voltage stress on the motor and converter. This does, however, reduce the possible peak power (P_{15}) with the square of the voltage $(841/967)^2 = 0.75$. The possible peak power is, therefore, max. 75 % of P_{15}.
	841 V	2	
660 V – 690 V	1158 V	1	1158 V is the default factory setting. With a supply voltage of 660 V, the response threshold can be set to 1070 V to reduce the voltage stress on the motor and converter. This does, however, reduce the possible peak power (P_{15}) with the square of the voltage $(1070/1158)^2 = 0.85$. The possible peak power is, therefore, max. 85 % of P_{15}.
	1070 V	2	

4.10.12 Thermistor Motor Protection Unit (Option L83/L84)

Description

This option includes the thermistor motor protection unit (with PTB approval) for PTC thermistor sensors (PTC resistor type A) for warning and shutdown. The power supply for the thermistor motor protection unit is provided inside the converter where the evaluation is also performed.

Option L83 triggers the "external alarm 1" (A7850) if a fault occurs.

Option L84 triggers the "external fault 1" (F7860) if a fault occurs.

Connection

Table 4-34 F127/F125 – connection for thermistor motor protection unit

Equipment designation	Functional description
F127 T1, T2	Thermistor motor protection (warning)
F125 T1, T2	Thermistor motor protection (shutdown)

The PTC thermistor sensors are connected directly to terminals T1 and T2 of the evaluation unit.

Table 4-35 Maximal line length for the sensor circuit

Line cross-section in mm²	Line length in m
2.5	2 x 2800
1.5	2 x 1500
0.5	2 x 500

Diagnostics

Messages output during operation and in the event of faults (meaning of LEDs on -A120, -A121) are described in "Additional Operating Instructions" in the operating manual.

4.10.13 PT100 Evaluation Unit (Option L86)

Description

NOTE

The PT100 evaluation unit and the parameters for the measurement channels are described in "Additional Operating Instructions".

The PT100 evaluation unit can monitor up to 6 sensors. The sensors can be connected using a two-wire or three-wire system. With the two-wire system, inputs

Tx1 and Tx3 must be assigned. With the three-wire system, input Tx2 must also be connected (x = 1, 2, ...6). The limit values can be programmed by the user for each channel. A shielded signal cable is recommended. If this is not possible, however, the sensor cables should at least be twisted in pairs.

In the factory setting, the measurement channels are divided into two groups of three channels. With motors, for example, three PT100 can, therefore, be monitored in the stator windings and two PT100 in the motor bearings. Channels that are not used can be masked out using appropriate parameter settings.

The output relays are integrated in the internal fault and warning train of the cabinet unit. The messages can also be picked up by the customer via two spare fault signaling relays. Two user-programmable analog outputs are also available (0/4 to 20 mA and 0/2 to 10 V) for integration in a higher-level controller. The power for the PT100 evaluation unit is supplied and the evaluation itself carried out within the converter.

In the event of a fault, the "external alarm 1" (A7850) and "external fault 1" (F7860).

Connection

Table 4-36 Terminal block -A1-A140 – connection for evaluation unit PT100 resistors

Terminals	Designation	Technical specifications
T11-T13		90 – 240 V AC/DC; PT100; sensor 1; group 1
T21-T23		90 – 240 V AC/DC; PT100; sensor 2; group 1
T31-T33		90 – 240 V AC/DC; PT100; sensor 3; group 1
T41-T43		90 – 240 V AC/DC; PT100; sensor 1; group 2
T51-T53		90 – 240 V AC/DC; PT100; sensor 2; group 2
T61-T63		90 – 240 V AC/DC; PT100; sensor 3; group 2
51/52/54		90 – 240 V AC/DC relay output limit value group 1 reached; (two-way contact)
61/62/64		90 – 240 V AC/DC relay output limit value group 2 reached; (two-way contact)
Ground _	OUT 1	0/4 – 20 mA 0/2 – 10 V analog output Out 1; sensor group 1
U1	OUT 1	
I1	OUT 1	
Ground _	OUT 2	0/4 – 20 mA 0/2 – 10 V analog output Out 2; sensor group 2
U2	OUT 2	
I2	OUT 2	

Max. connectable cross-section: 2.5 mm² (AWG 12)

Diagnostics

Messages output during operation and in the event of faults (meaning of LEDs on -A140) are described in "Additional Operating Instructions" in the operating manual.

4.10.14 Insulation Monitor (Option L87)

Description

This device monitors the complete electrically connected circuit for insulation faults. The insulation resistance as well as all the insulation faults that occur in the DC link and on the motor side of the cabinet are detected. Two response values (between 1 kΩ ...10 MΩ) can be set. If a response value in undershot, a warning is output to the terminal. A system fault is output via the signaling relay system.

When the cabinet unit is delivered from the plant, the plant configuration (one or several loads in one electrically connected network) and the protection philosophy (immediate shutdown in the event of an insulation fault or restricted continued motion) can vary. This means that the signaling relays of the insulation monitor are not integrated in the fault and warning train. These relay outputs would have to be integrated in the fault/warning train of the cabinet unit on the system side providing the plant configuration and protection philosophy permit this.

NOTE

When the insulation monitor is used, the connection bracket for the interference-suppression capacitor must be removed (see Section 4.7.6).

IMPORTANT

Only one insulation monitor can be used in an electrically connected network.

Connection

Table 4-37 Terminal block A1-A101 – connection for one insulation monitor

Terminals	Technical specifications
11	Signaling relay ALARM 1 (mid-position contact)
12	Signaling relay ALARM 1 (NC contact)
14	Signaling relay ALARM 1 (NO contact)
21	Signaling relay ALARM 2 (mid-position contact)
22	Signaling relay ALARM 2 (NC contact)
24	Signaling relay ALARM 2 (NO contact)
M+	External kΩ display, analog output (0 μA ... 400 μA)
M-	External kΩ display, analog output (0 μA ... 400 μA)
R1	External reset key (NC contact or wire jumper otherwise the fault code is not stored)
R2	External reset key (NC contact or wire jumper)
T1	External test button
T2	External test button

Max. connectable cross-section: 2.5 mm² (AWG 12)

Diagnostics

Messages output during operation and in the event of faults (meaning of LEDs on –A101) are described in "Additional Operating Instructions" in the operating manual.

4.10.15 Sensor Module SMC30 for Detecting the Actual Motor Speed (Option K50)

4.10.15.1 Description

The SMC30 sensor module is used for determining the actual motor speed. The signals emitted by the rotary pulse encoder are converted here and made available via the DRIVE-CLiQ interface of the closed-loop control for evaluation purposes.

The following encoders can be connected to the SMC30 sensor module:

- TTL encoder
- HTL encoder
- KTY temperature sensor

Table 4-38 Encoders that can be connected with supply voltage

Sensor type	Remote sense	X520 (D-Sub)	X521 (terminal)	X531 (terminal)	Interrupted cable monitoring
HTL bipolar 24 V	No	Not possible	Yes	Yes	Not possible
HTL unipolar 24 V	No	Not possible	Yes	Yes	Not possible
TTL bipolar 24 V	No	Yes	Yes	Yes	Only at X520
TTL bipolar 5 V	Only at X520	Yes	Yes	Yes	Only at X520
TTL unipolar	Not possible				

Table 4-39 Max. signal cable lengths

Sensor type	Maximum signal cable length in m
TTL	100
HTL unipolar	100
HTL bipolar	300

NOTE

For HTL encoders, in order to reduce the effect of interference, a bipolar connection is recommended.

For encoders with a 5 V supply at X521/X531, the cable length is dependent on the encoder current (this applies cable cross-sections of 0.5 mm²):

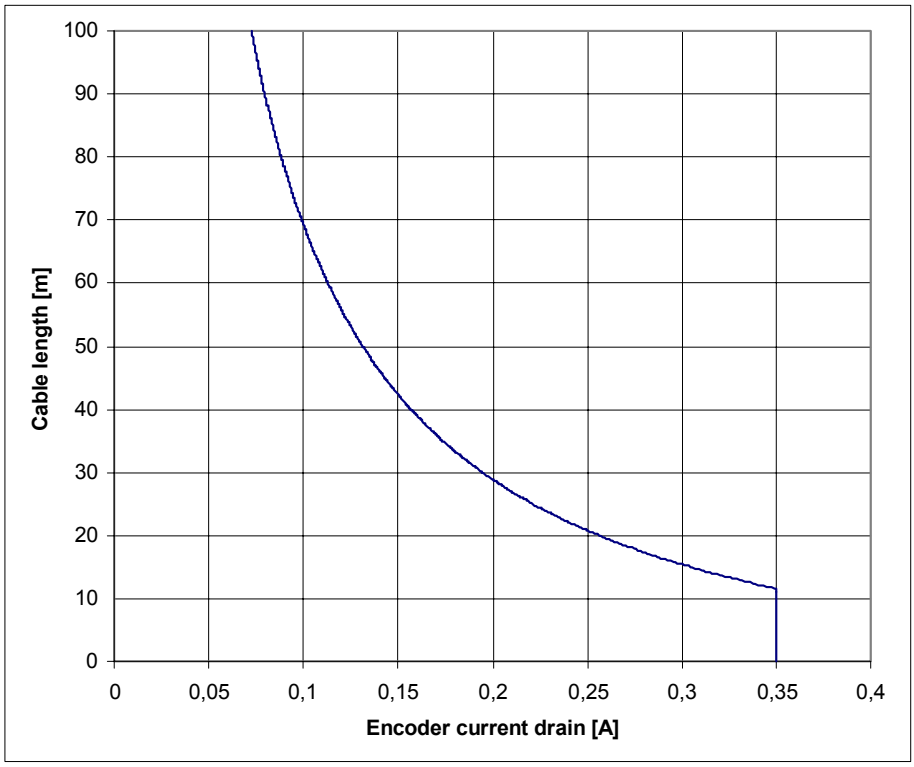


Fig. 4-13 Signal cable length as a function of the encoder current drain

Properties of encoders that can be connected

Table 4-40 Properties of encoders that can be connected

Parameter	Name	Unit	Min.	Max .
Signal level high (TTL bipolar at X520 or X521/X531)	U_H	V	2	
Signal level low (TTL bipolar at X520 or X521/X531)	U_L	V		-2
Signal level high (HTL unipolar)	U_H	V	10	V_{CC}
Signal level low (HTL unipolar)	U_L	V		2
Signal level high (HTL bipolar)	U_H	V	3	V_{CC}
Signal level low (HTL bipolar)	U_L	V		-3
Signal frequency	f_S	kHz		500
Identification range	α1; α2	Degrees	50	270

The encoder supply voltage V_{CC} is max. 30 V.

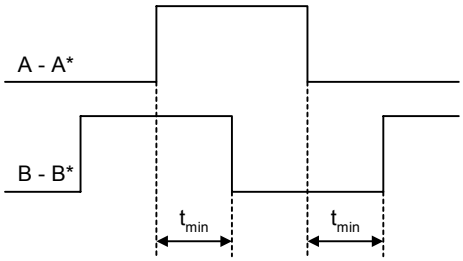


Fig. 4-14 Time between two edges for pulse encoders

The minimum time t_{min} between two edges is 250 ns.

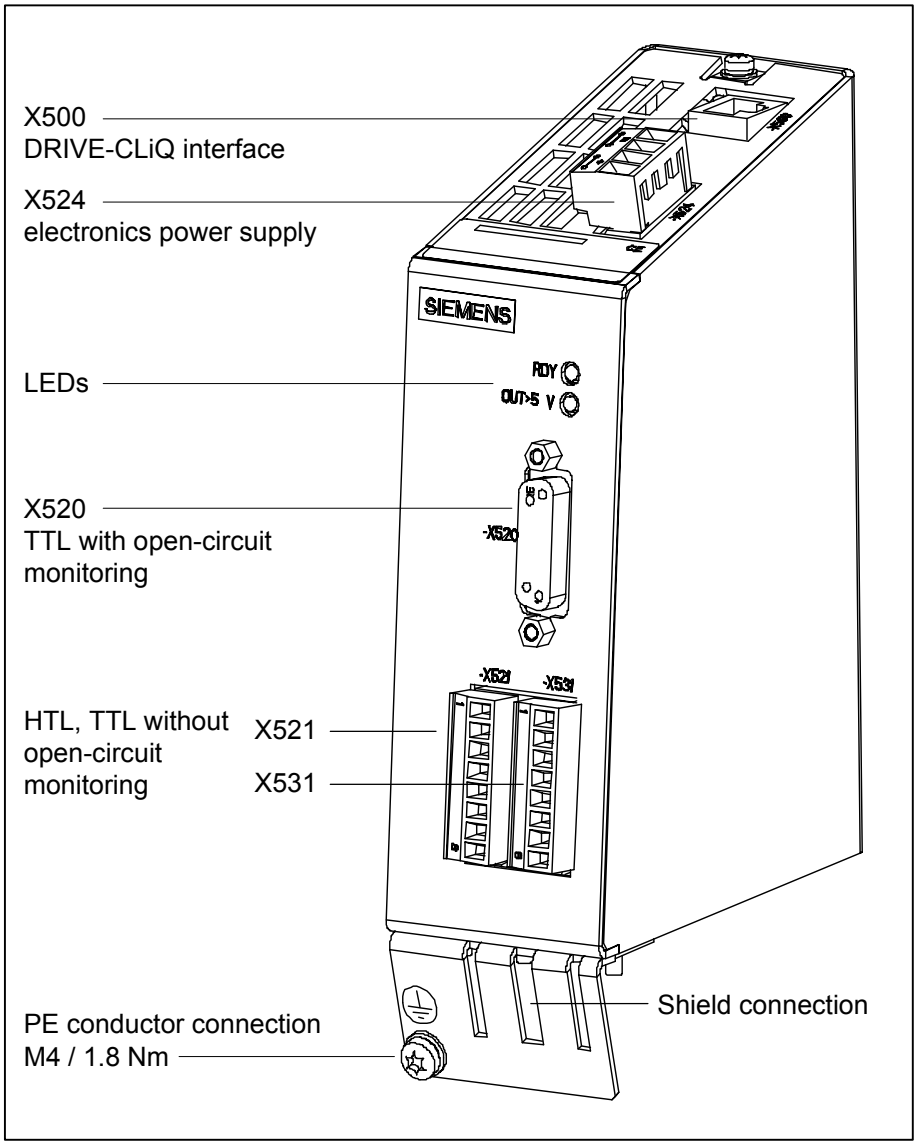
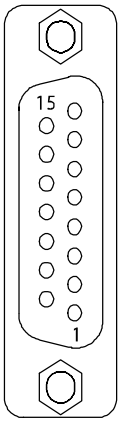


Fig. 4-15 SMC30 sensor module

4.10.15.2 Connection

X520: Encoder Connection 1 for TTL Encoder with Open-Circuit Monitoring

Table 4-41 Encoder connection X520

	Pin	Signal name	Technical specifications
	1	Reserved, do not use	
	2	Reserved, do not use	
	3	Reserved, do not use	
	4	P_Encoder 5 V / 24 V	Sensor power supply
	5	P_Encoder 5 V / 24 V	Sensor power supply
	6	P_Sense	Sense input sensor power supply
	7	M_Encoder (M)	Ground for sensor power supply
	8	Reserved, do not use	
	9	M_Sense	Ground sense input
	10	R	Reference signal R
	11	R*	Inverted reference signal R
	12	B*	Inverted incremental signal B
	13	B	Incremental signal B
	14	A*	Inverted incremental signal A
	15	A	Incremental signal A

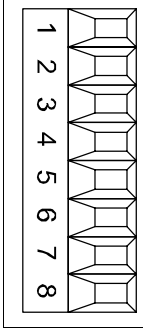
Plug type: 15-pin socket

CAUTION

The sensor power supply can be parameterized to 5 V or 24 V. The sensor may be destroyed if you enter the wrong parameters.

X521 / X531: Encoder Connection 2 for HTL/TTL Encoder Without Open-Circuit Monitoring

Table 4-42 Encoder connection X521

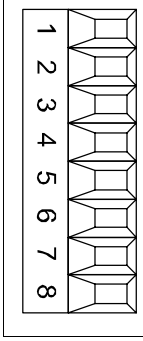
	Terminal	Signal name	Technical specifications
	1	A	Incremental signal A
	2	A*	Inverted incremental signal A
	3	B	Incremental signal B
	4	B*	Inverted incremental signal B
	5	R	Reference signal R
	6	R*	Inverted reference signal R
	7	CTRL	Control signal
	8	M	Ground via inductivity

Max. connectable cross-section: 1.5 mm² (AWG 14)

NOTE

When unipolar HTL encoders are used, A*, B*, and R* on the terminal block must be jumpered with M_Encoder (X531).

Table 4-43 Encoder connection X531

	Terminal	Signal name	Technical specifications
	1	P_Encoder 5 V / 24 V	Sensor power supply
	2	M_Encoder	Ground for sensor power supply
	3	-Temp	Motor temperature sensing KTY84-1C130 Temperature sensor connection KTY84-1C130/PTC
	4	+Temp	
	5	Reserved, do not use	
	6	Reserved, do not use	
	7	Reserved, do not use	
	8	Reserved, do not use	

Max. connectable cross-section: 1.5 mm² (AWG 14)

NOTE

Ensure that when the sensor is connected via terminals, the cable shield must be placed on the module.

4.10.15.3 Connection Examples

Connection Example 1: HTL Encoder, Bipolar, Without Zero Marker -> p0405 = 9 (Hex)

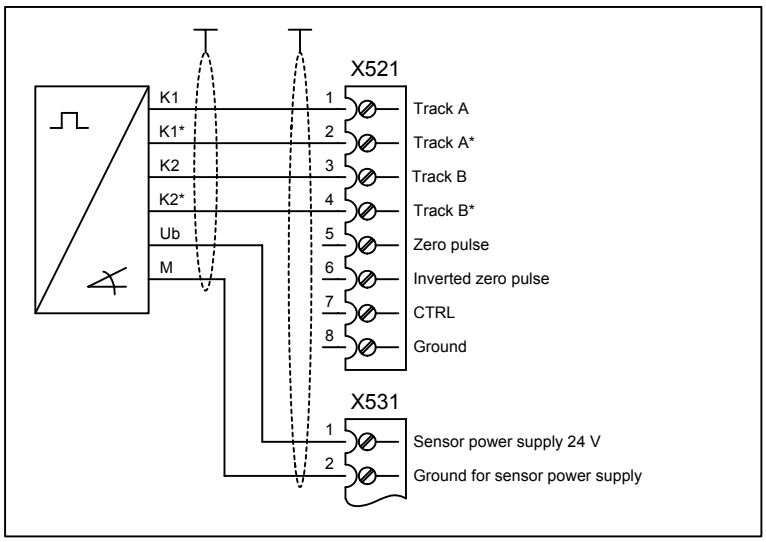


Fig. 4-16 Connection example 1: HTL encoder, bipolar, without zero marker

Connection Example 2: TTL Encoder, Unipolar, Without Zero Marker -> p0405 = A (Hex)

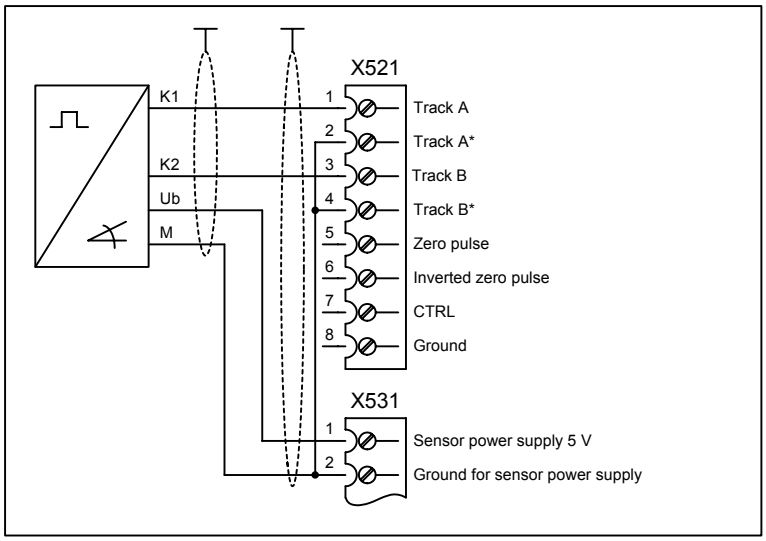


Fig. 4-17 Connection example 2: TTL encoder, unipolar, without zero marker

4.10.16 Customer Terminal Block Extension (Option G61)

Description

A TM31 interface module (customer terminal block –A60) is already installed in standard SINAMICS S150 cabinet units. A second module (–A61) provides the following additional digital and analog inputs/outputs in the drive system:

- 8 digital inputs
- 4 bidirectional digital inputs/outputs
- 2 relay outputs with changeover contact
- 2 analog inputs
- 2 analog outputs
- 1 temperature sensor input (KTY84-130/PTC)

The second TM31 must be installed on the system side. Default settings are not provided.

4.10.17 NAMUR Terminal Block (Option B00)

Description

The terminal block is designed in accordance with the requirements and guidelines defined by the standards association for measurement and control systems in the chemical industry (NAMUR – recommendation NE37), that is, certain device functions are assigned to fixed terminals. The inputs and outputs assigned to the terminals fulfill PELV ("protective extra-low voltage and protective separation") requirements.

The terminal block only contains the necessary functions. Unlike the NAMUR recommendation, optional terminals are not available.

The 24 V DC is supplied on the system side via terminals –A1-X2:1-3 (protected with 1 A within the converter). You must ensure that the PELV safety requirements (protective extra-low voltage with protective separation) are fulfilled.

To monitor the temperature of explosion-proof motors, option B00 features a PTC thermistor release mechanism with PTB approval. Shutdown if limit value is exceeded. The associated PTC sensor is connected to terminal –A1-X3:90, 91.

The terminal block is divided into three sections:

- -X1; -X2: for the power connections
- -A1-X2: for signal cables, which must fulfill PELV requirements with electrical separation.
- -A1-X3: for connecting the motor PTC thermistor detector

Connection

Table 4-44 Terminal block -A1-X2 – connection for 24 V supply

Terminal	Designation	Preassignment	Comments
1	M	Reference conductor	
2	P24 V	24 V DC supply	Protected internally with fuse (1 A)
3	P24 V	24 V DC outgoing circuit	

Max. connectable cross-section: 2.5 mm² (AWG 12)

Table 4-45 Terminal block A1-X2 – connection for NAMUR control terminal block

Terminal	Designation	Preassignment	Comments
10	DI	ON (dynamic) / ON/OFF (static)	Effective operation can be coded by a wire jumper on terminal –A1-400:9;10.
11	DI	OFF (dynamic)	
12	DI	Faster	Motorized potentiometer
13	DI	Slower	Motorized potentiometer
14	DI	RESET	Acknowledge error
15	DI	Interlock	OFF2
16	DI	CCW rotation	“0” signal: CW phase sequence ”1” signal: CCW phase sequence
17		Line disconnection	EMERGENCY OFF circuit
18			
30		Ready	Relay output (NO contact)
31			
32		Motor rotates	Relay output (NO contact)
33			
34	DO (NO)	Fault	Relay output (two-way contact)
35	DO (COM)		
36	DO (NC)		
50/51	AI 0/4-20 mA	Speed setpoint	
60/61	AO 0/4-20 mA	Motor frequency	
62/63	AO 0/4-20 mA	Motor current	(Defaulted with motor current – can be reparameterized for other variables.)

Max. connectable cross-section: 2.5 mm² (AWG 12)

Table 4-46 Terminal block -A1-X3 – connection for motor PTC thermistor detector

Terminal	Designation	Preassignment	Comments
90/91	AI	Connection for a PTC detector	Shutdown if limit value is exceeded.

Max. connectable cross-section: 2.5 mm² (AWG 12)

4.10.18 Separate 24 V DC Power Supply for NAMUR (Option B02)

Description

If the customer cannot provide a separate 24 V DC supply (PELV), this option enables a second power supply to be installed for ensuring the PELV. (Terminal assignment identical to option B00; no 24 V supply at terminals –A1-X1: 1, 2, 3.)

4.10.19 Outgoing Section for External Auxiliary Equipment for NAMUR (Option B03)

Description

If power is to be supplied to a motor fan on site, option B03 provides an uncontrolled fuse-protected (10 A) outgoing section. As soon as the supply voltage is present at the converter input, it is also present at these terminals. The voltage is the same as the converter input voltage. You must take this into account when configuring the separately driven fan.

Connection

Table 4-47 Terminal block -A1-X1 – uncontrolled outgoing power section (10 A) for supplying a separately driven motor fan

Terminal	Preassignment	Comments
1, 2, 3, PE	Outgoing section for separately driven motor fan	$V = V_{supply}$

Max. connectable cross-section: 2.5 mm² (AWG 12)

4.10.20 PROFIdrive NAMUR (option B04)

Description

In this case, communications to the higher-level master control level are not realized via the standardized analog interface (terminal strip), but via a standardized bus protocol and the Profibus interface. Here, the information (data) exchange, the information contents and the device reactions and responses are defined in the communication and device profile.

Connection

Table 4-48 Terminal block -A1-X2 – 24 V supply voltage connection

Terminal	Name	Default	Comment
1	M	Reference conductor	
2	P24 V	24 V DC supply	Protected internally with fuse (1 A)
3	P24 V	24 V DC outgoing circuit	

Max. connectable cross-section: 2.5 mm² (AWG 12)

Table 4-49 Terminal -A1-X2 – connection, NAMUR control terminal strip

Terminal	Name	Default	Comment
15	DI	Interlock	OFF2
19	P24 V		
17		Line disconnection	EMERGENCY STOP circuit
18			

Max. connectable cross-section: 2.5 mm² (AWG 12)

Table 4-50 Terminal block -A1-X3 – connection for the motor PTC thermistor sensor

Terminal	Name	Default	Comment
90/91	AI	Connection for a PTC detector	Shutdown if limit value is exceeded.

Max. connectable cross-section: 2.5 mm² (AWG 12)

■

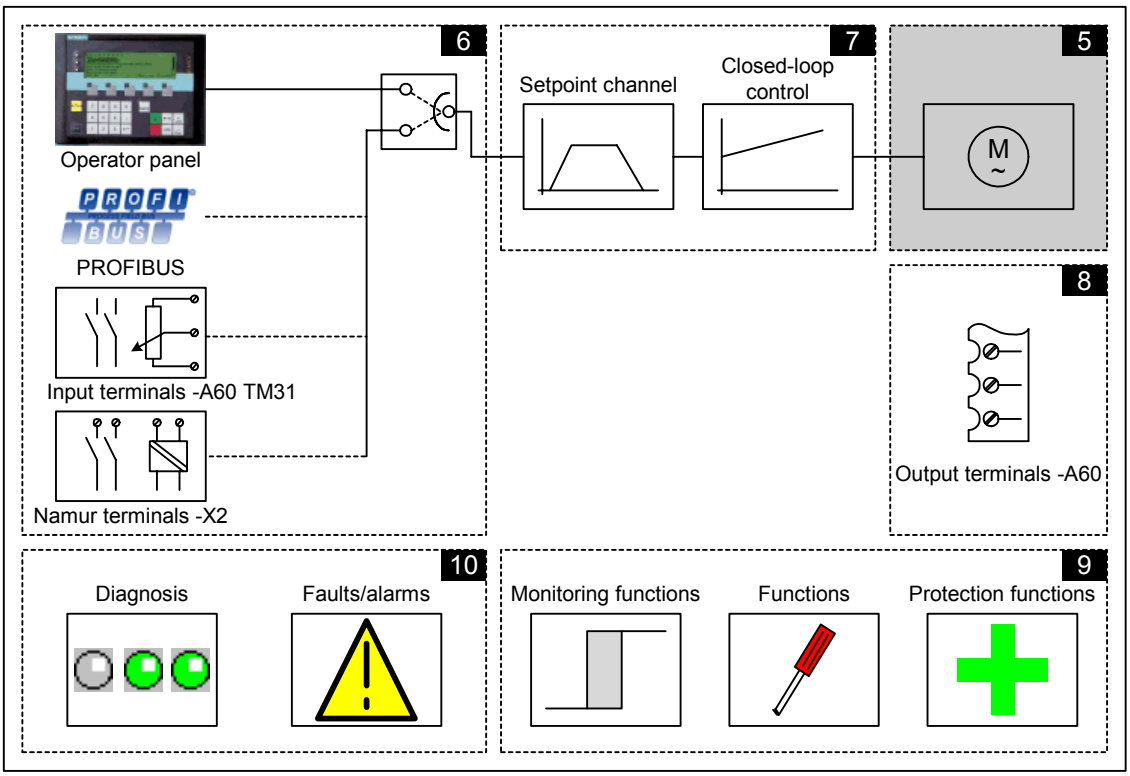
Commissioning

5

5.1 Chapter Content

This chapter provides information on the following:

- An overview of the operator panel functions
- Initial commissioning of the cabinet (initialization)
  - Entering the motor data (drive commissioning)
  - Entering the most important parameters (basic commissioning), concluding with the motor ID
- Data backup
- Parameter reset to factory settings



5.2 The STARTER Commissioning Tool

Description

You can use the **STARTER** commissioning tool to configure and commission SINAMICS drives and drive systems. The drive can be configured using the STARTER drive configuration Wizard.

NOTE

This chapter shows you how to carry out commissioning using STARTER.
STARTER features a comprehensive online help function, which provides detailed explanations of all the processes and available system settings.
This chapter will, therefore, only look at commissioning.

Prerequisites for Installing STARTER

Minimum hardware requirements:

- PG or PC with:
- Pentium II 400 MHz (Windows NT/2000)
- Pentium III 500 MHz (Windows XP)
- 256 MB RAM
- 1024 x 768 pixel screen resolution

Minimum software requirements:

- Either Windows NT 4.0 SP6
- or Windows 2000 SP3
- or Windows XP Professional SP1
- and Internet Explorer V5.0.1

5.2.1 Installing STARTER

STARTER is installed using the “setup” file on the CD supplied. When you double-click the “setup” file, the installation Wizard guides you through the process of installing STARTER.

5.2.2 The STARTER User Interface

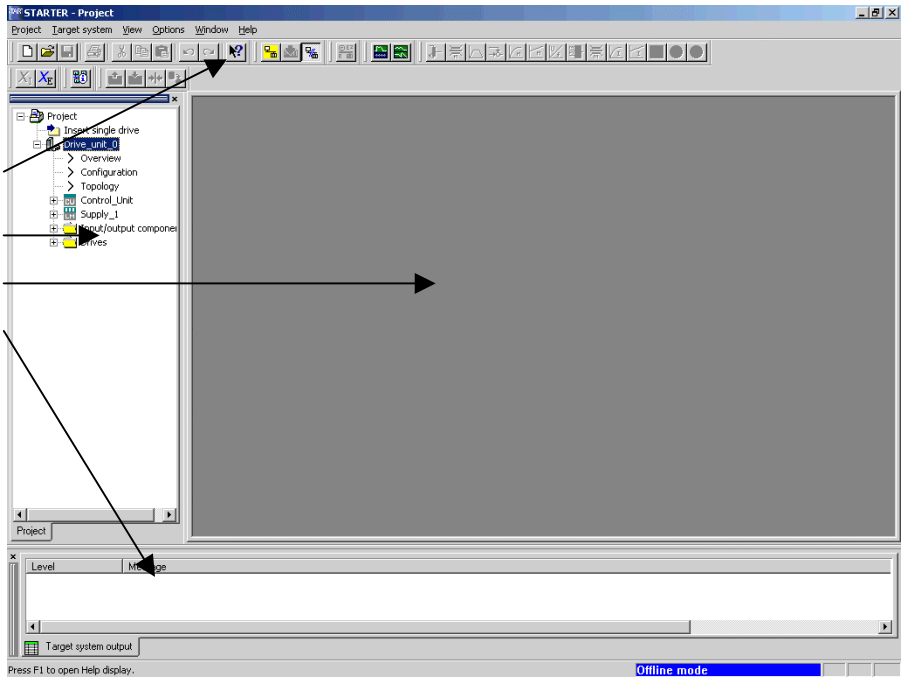
STARTER features four operating areas:

Toolbar

Project navigator

Working area

Detail view



Operating area	Explanation
Toolbar	In this area, you can access frequently used functions by clicking icons.
Project navigator	The elements and projects available in the project are displayed here.
Working area	In this area, you can change the settings for the drive units.
Detail view	Detailed information about faults and alarms, for example, is displayed this area.

5.3 Commissioning Using STARTER

Basic Procedure Using STARTER

STARTER uses a sequence of dialog screens for entering the required drive unit data.

IMPORTANT

These dialog screens contain default settings, which you may have to change according to your application and configuration.

This is intentional!
Aim: By taking time to consider what configuration data you enter, you can prevent inconsistencies between the project data and drive unit data (identifiable in online mode).

5.3.1 Creating Your Project

Click the STARTER icon on your desktop or choose the following menu path in the Windows start menu to call up STARTER: Start > Simatic > STEP 7 > STARTER.

The first time you run the software, the main screen (shown below) appears with the following windows:

- STARTER Getting Started Drive Commissioning
- STARTER Project Wizard

The commissioning steps are listed below in numerical order.

Accessing the STARTER Project Wizard

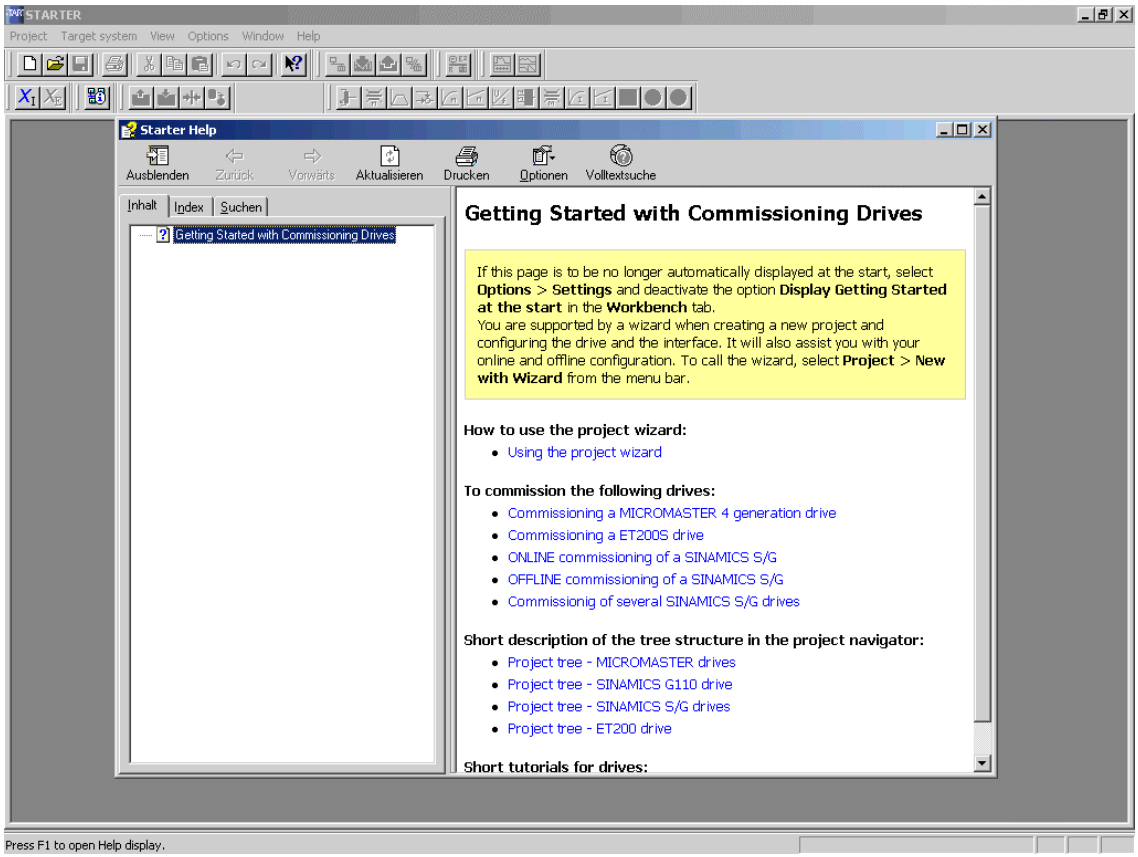

STARTER
Project Target system View Options Window Help
Starter Help
Ausblenden Zurück Vorwärts Aktualisieren Drucken Optionen Volltextsuche
Inhalt Index Suchen
Getting Started with Commissioning Drives
Getting Started with Commissioning Drives
If this page is to be no longer automatically displayed at the start, select Options > Settings and deactivate the option Display Getting Started at the start in the Workbench tab.
You are supported by a wizard when creating a new project and configuring the drive and the interface. It will also assist you with your online and offline configuration. To call the wizard, select Project > New with Wizard from the menu bar.
How to use the project wizard:
Using the project wizard
To commission the following drives:
Commissioning a MICROMASTER 4 generation drive
Commissioning a ET200S drive
ONLINE commissioning of a SINAMICS S/G
OFFLINE commissioning of a SINAMICS S/G
Commissionig of several SINAMICS S/G drives
Short description of the tree structure in the project navigator:
Project tree - MICROMASTER drives
Project tree - SINAMICS G110 drive
Project tree - SINAMICS S/G drives
Project tree - ET200 drive
Short tutorials for drives:
Press F1 to open Help display.

Fig. 5-1 Main screen for the STARTER parameterization and commissioning tool

1. Close the “STARTER Getting Started Drive Commissioning” screen by choosing **HTML Help > Close**.

NOTE

When you deactivate the **Display Wizard during start** checkbox, the project Wizard is no longer displayed the next time you start STARTER.

You can call up the project Wizard by choosing **Project > New with Wizard**.

To deactivate the online help for **Getting Started**, follow the instructions provided in Help.

You can call up the online help at any time by choosing **Help –> Getting Started**.

STARTER features a detailed online help function.

The STARTER Project Wizard

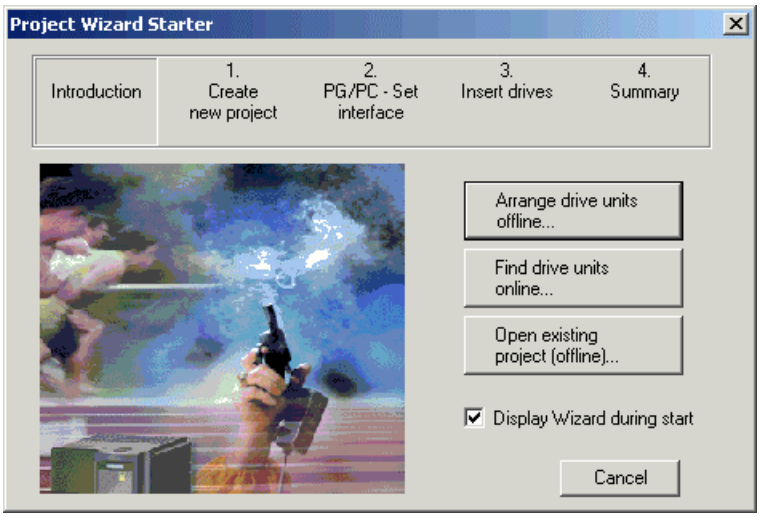


Fig. 5-2 The STARTER project Wizard

2. Click **Arrange drive units offline...** in the STARTER project Wizard.

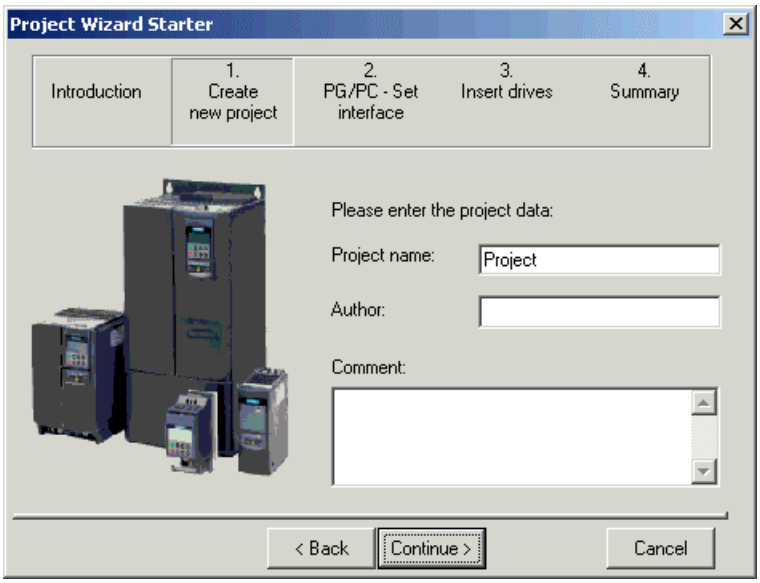


Fig. 5-3 Creating a new project

3. Enter the **project name** and, if necessary, the **author** and a **comment**.
4. Click **Continue >** to set up a PROFIBUS interface in the PG/PC.

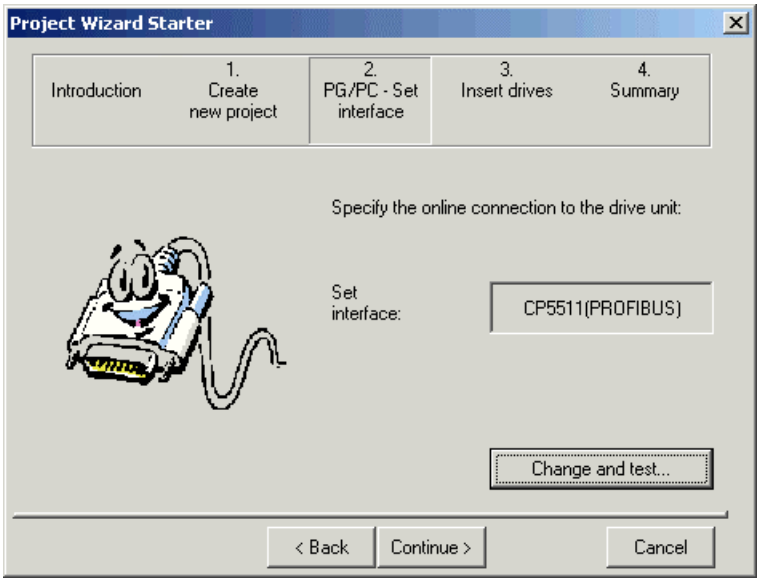


Fig. 5-4 Setting up the interface

NOTE

The online connection to the drive unit can only be established via PROFIBUS,

5. Click **Change and test...** and set up the interface in accordance with your device configuration.
   The **Properties...**, **Diagnostics...**, **Copy...**, and **Select...** pushbuttons are now active.

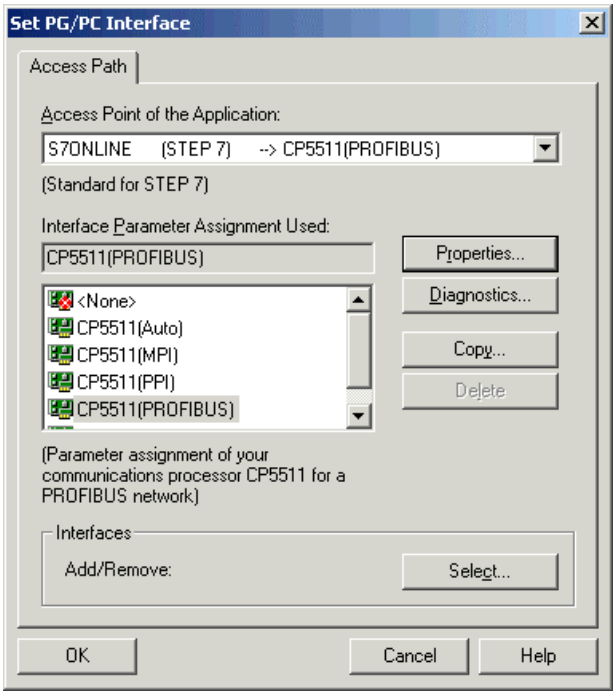


Fig. 5-5 Setting the interface

NOTE

To parameterize the interface, you must install the appropriate interface card (e.g.: CP5511).

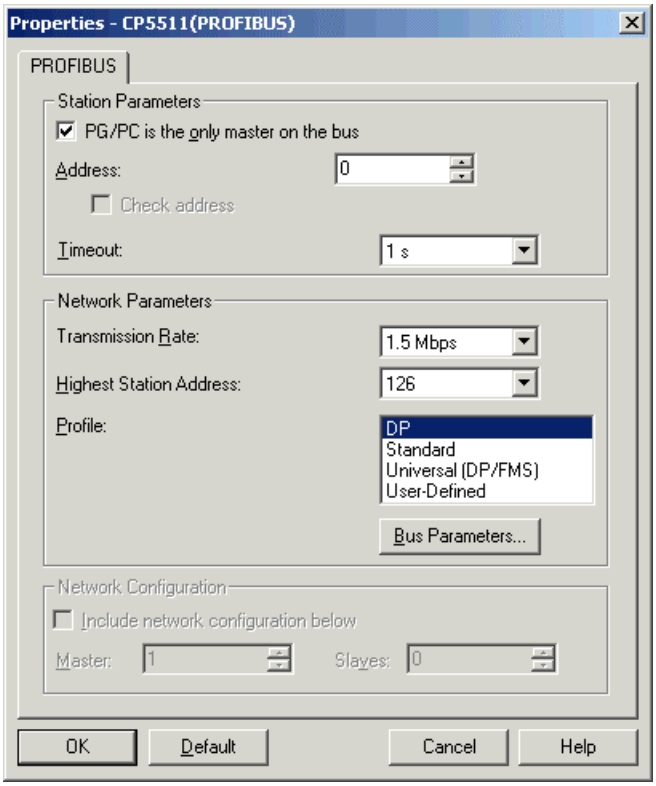


Fig. 5-6 Setting the interface properties

IMPORTANT

You must activate **PG/PC is the only master on bus** if no other master (PC, S7, etc.) is available on the bus.

NOTE

Projects can be created and PROFIBUS addresses for the drive objects assigned even if a PROFIBUS interface has not been installed on the PC.

To prevent bus addresses from being assigned more than once, only the bus addresses available in the project are proposed.

6. Once you have done this, click **OK** to confirm the settings and return to the project Wizard.

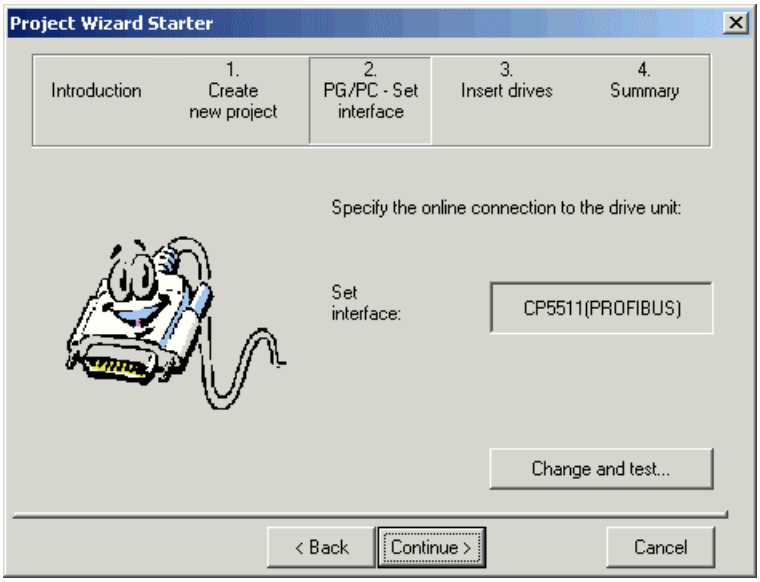


Fig. 5-7 Setting the interface

7. Click **Continue >** to set up a drive unit in the project Wizard, as shown below.

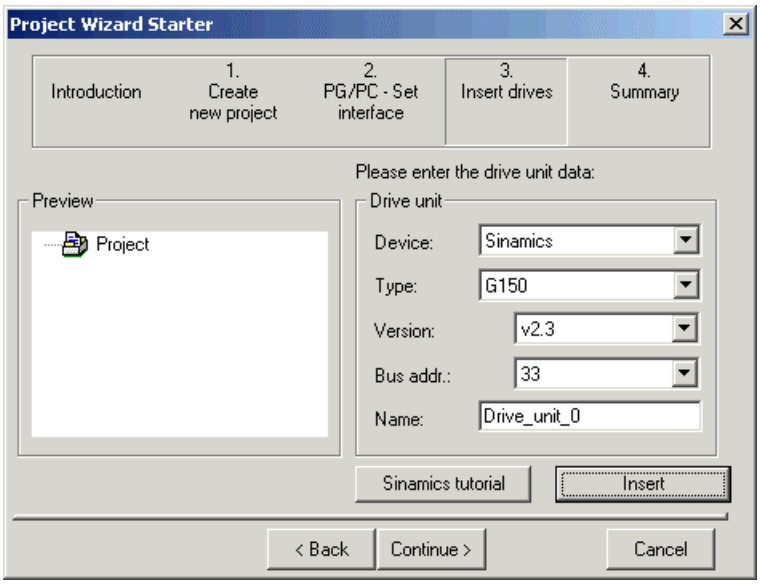


Fig. 5-8 Inserting a drive unit

8. Choose the following data from the list fields:
   Device: Sinamics
   Type: G150
   Version: v2.3
   Bus address: The corresponding bus address for the converter
   Entry in the **Name** field: As required

9. Click **Insert**.
   The selected drive unit is displayed in a preview window in the project Wizard.

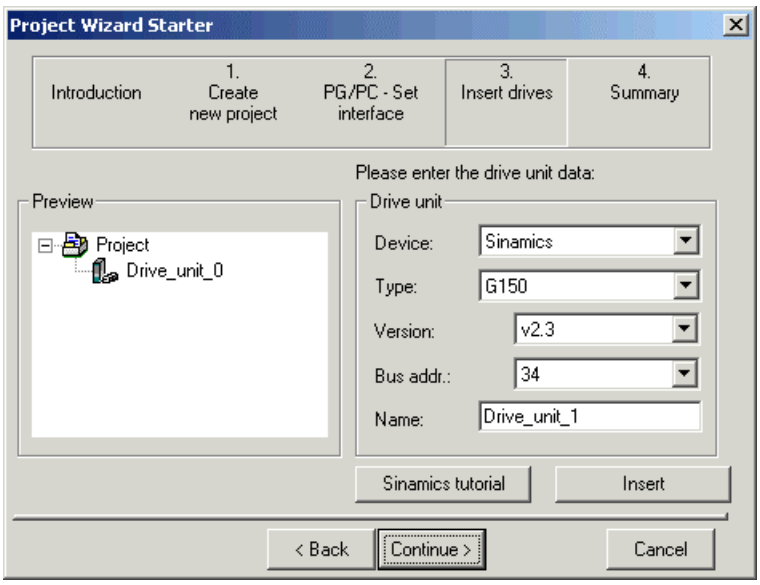


Fig. 5-9 Inserting a drive unit

10. Click **Continue >**.
    A project summary is displayed.

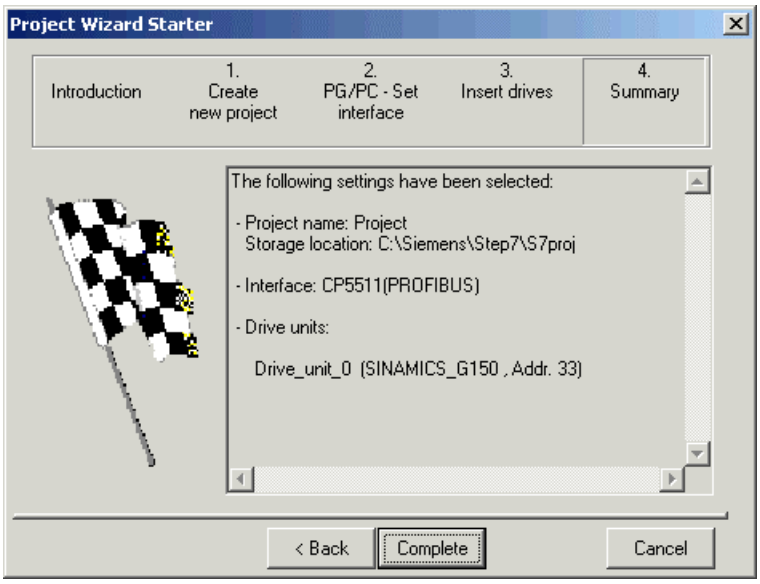


Fig. 5-10 Summary

11. Click **Complete** to finish creating a new drive unit project.

5.3.2 Configuring the Drive Unit

In the project navigator, open the component that contains your drive unit.

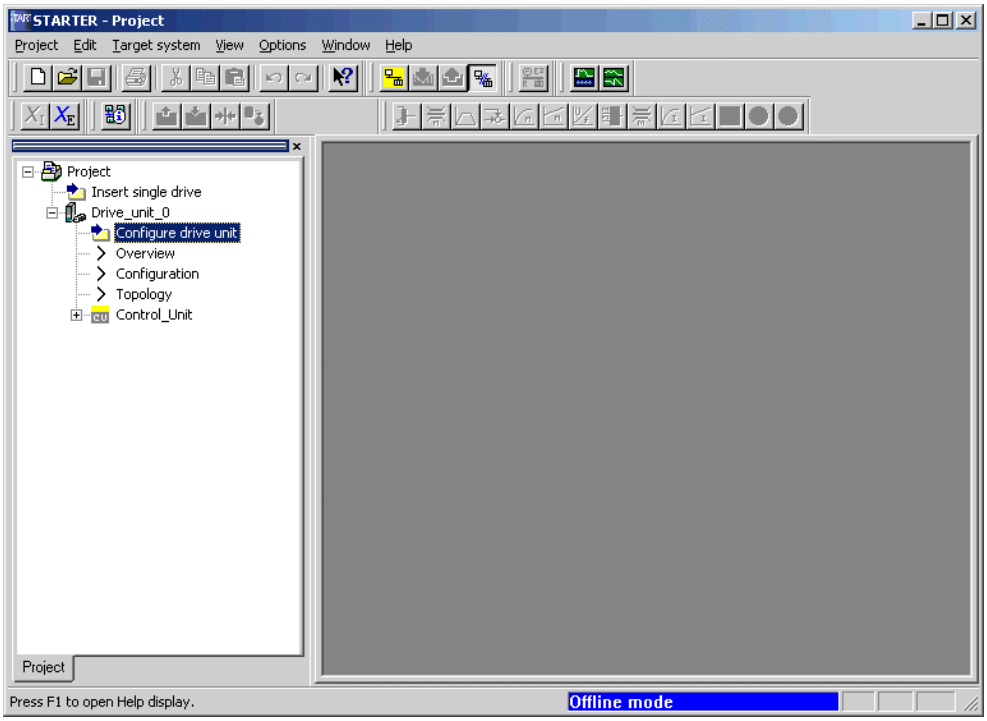


Fig. 5-11 Project navigator – configuring the drive unit

1. In the project navigator, click the plus sign next to the drive unit that you want to configure.
   The plus sign becomes a minus sign and the drive unit configuration options are displayed as a tree below the drive unit.
2. Double-click "Configure drive unit".

Configure the Drive Unit

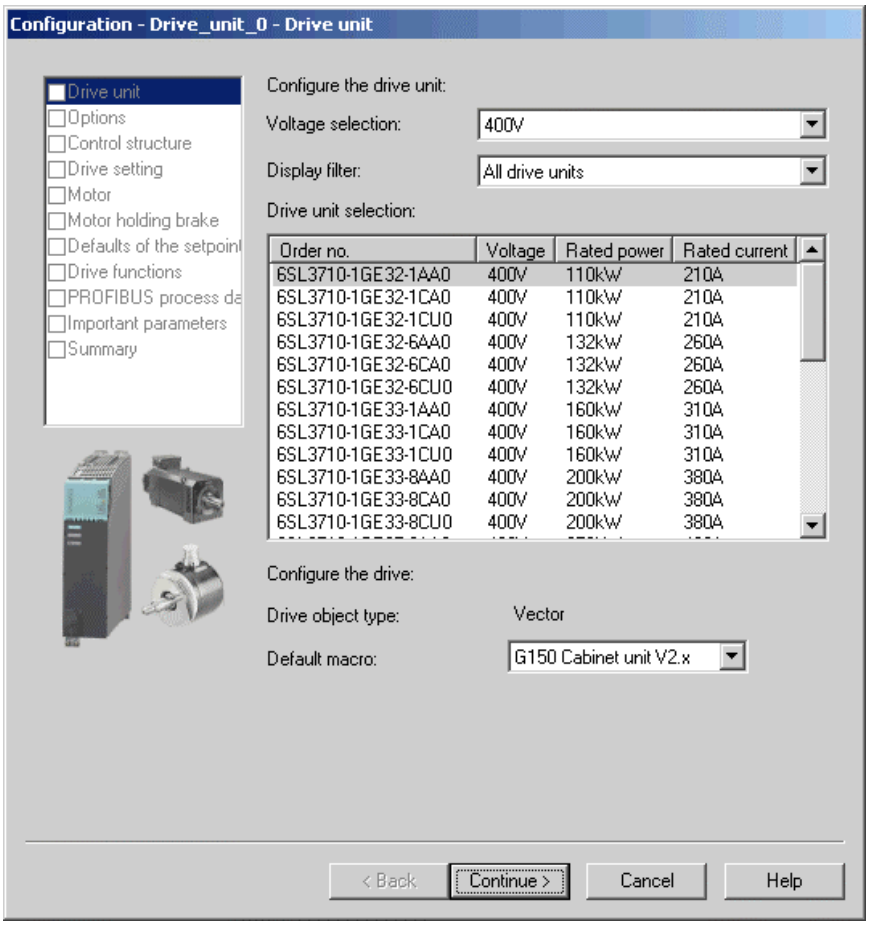


Fig. 5-12 Configuring the drive unit

3. In **Voltage selection:**, select the appropriate voltage and, in **Display filter:**, the appropriate cooling method for your drive unit.

NOTE

In this step, you make a preliminary selection of the cabinet units. You do not define the supply voltage and cooling method yet.

---

4. A list is now displayed under **Drive unit selection:**. Choose the corresponding drive unit according to type (order no.) (see the type plate).
5. Click **Continue >**.

Choosing the Options

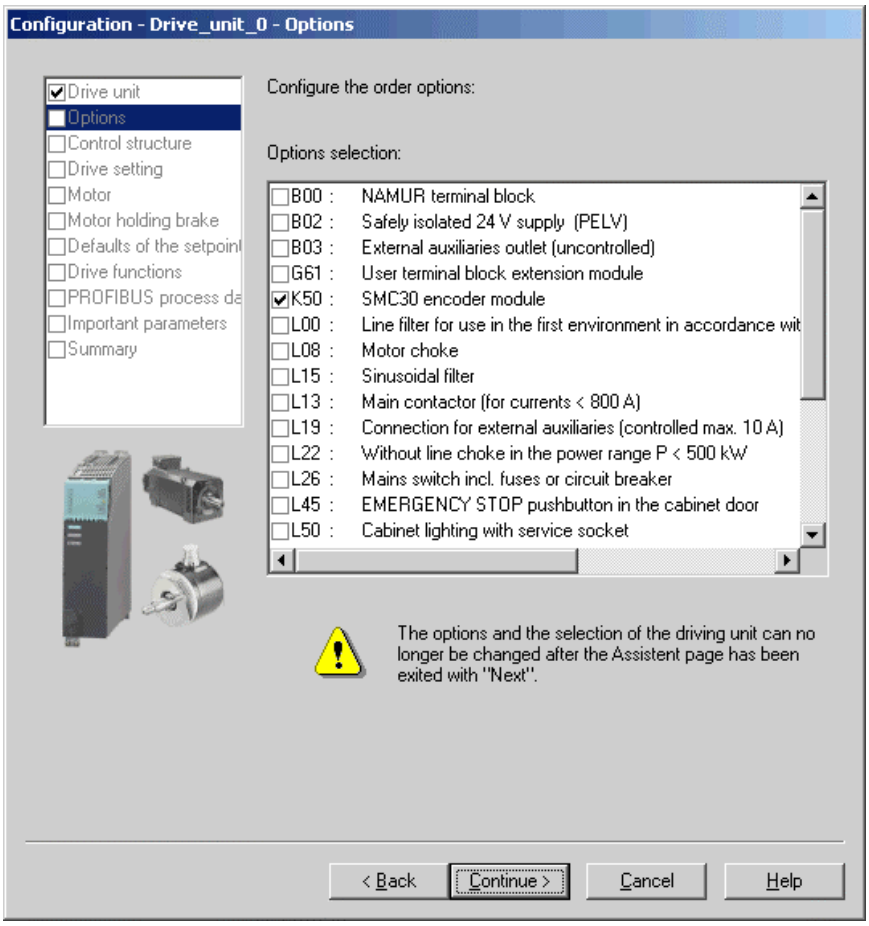

Configuration - Drive_unit_0 - Options
Drive unit
Options
Control structure
Drive setting
Motor
Motor holding brake
Defaults of the setpoint
Drive functions
PROFIBUS process da
Important parameters
Summary
Configure the order options:
Options selection:
B00 : NAMUR terminal block
B02 : Safely isolated 24 V supply (PELV)
B03 : External auxiliaries outlet (uncontrolled)
G61 : User terminal block extension module
K50 : SMC30 encoder module
L00 : Line filter for use in the first environment in accordance wit
L08 : Motor choke
L15 : Sinusoidal filter
L13 : Main contactor (for currents < 800 A)
L19 : Connection for external auxiliaries (controlled max. 10 A)
L22 : Without line choke in the power range P < 500 kW
L26 : Mains switch incl. fuses or circuit breaker
L45 : EMERGENCY STOP pushbutton in the cabinet door
L50 : Cabinet lighting with service socket
The options and the selection of the driving unit can no longer be changed after the Assistent page has been exited with "Next".
< Back
Continue >
Cancel
Help

Fig. 5-13 Choosing the options

6. In the **Option selection:** combination field, choose the options that belong to your drive unit by clicking the corresponding checkboxes (see type plate).

CAUTION

If a sinusoidal filter (option L15) is connected, it must be activated when the options are selected to prevent the filter from being destroyed.

NOTE

Check your options carefully against the options specified on the type plate.

The Wizard makes internal connections on the basis of the options you have selected, which means that you can no longer change your options by pressing the **< Back** pushbutton.
If you have made an incorrect entry, you have to delete the entire drive unit from the project navigator and add a new one.

---

7. Carefully check your options and then click **Continue >**.

Selecting the Control Structure

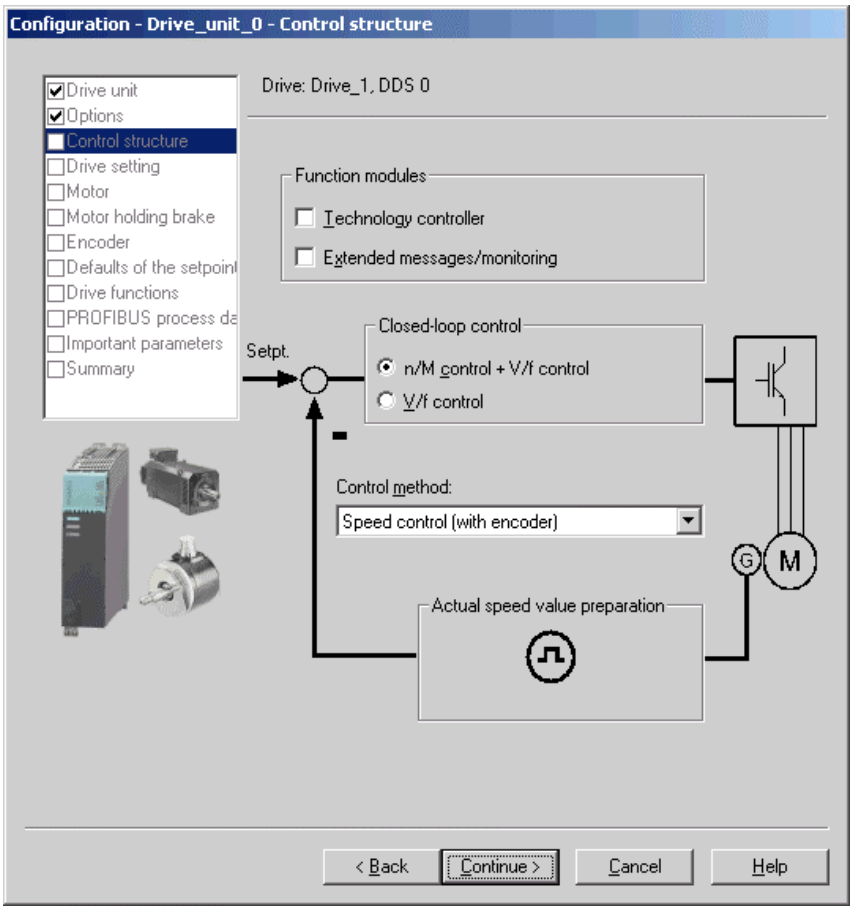


Fig. 5-14 Selecting the control structure

8. Select the required data:
   - **Function modules:**
     Select the function modules required in your application:
     - Technology controller
     - Extended messages/monitoring
   - **Control type:**
     Choose one of the following open-loop/closed-loop control types:
     - Torque control (without sensor)
     - Torque control (with sensor)
     - Speed control (without sensor)
     - Speed control (with sensor)
     - V/f control for precise frequency-controlled drives with FCC
     - V/f control for precise frequency-controlled drives (textiles)
     - V/f control with linear characteristic
     - V/f control with linear characteristic and FCC
     - V/f control with parabolic characteristic
     - V/f control with parameterizable characteristic
     - V/f control with independent voltage setpoint
9. Click **Continue >**.

Configuring the Drive Unit Properties

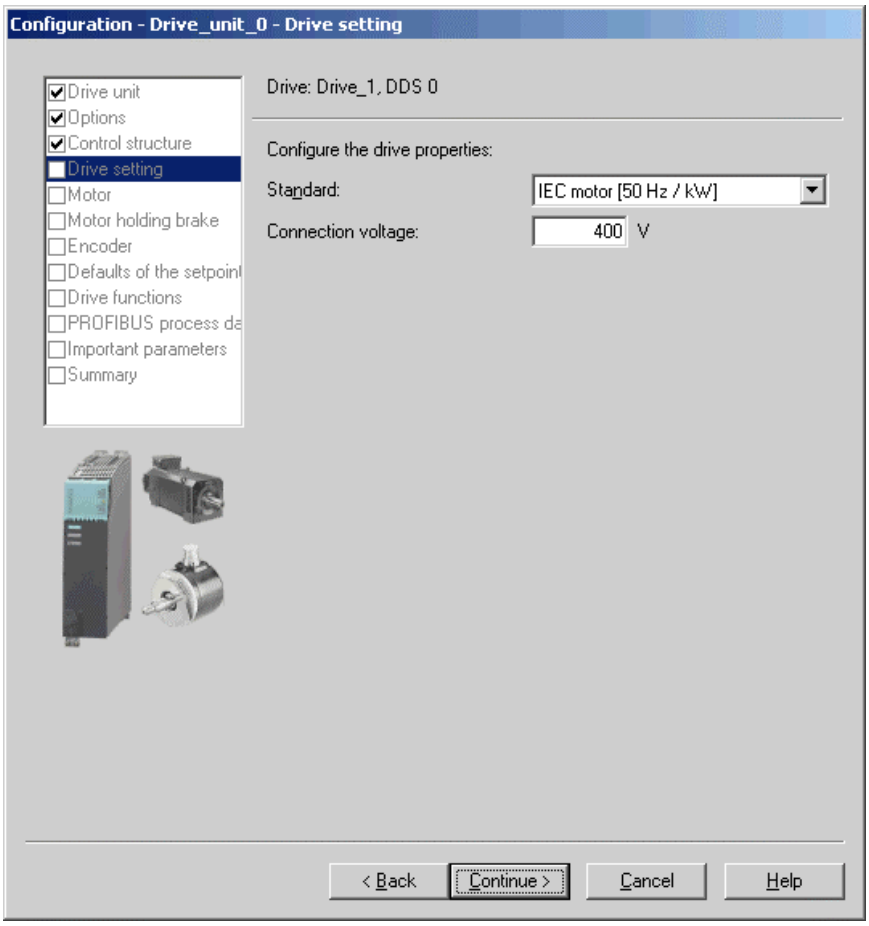


Fig. 5-15 Configuring the drive unit properties

10. In **Standard:**, choose the appropriate standard for your motor.
    The following standards are defined:
    IEC motor [50 Hz / kW]: Line frequency 50 Hz, motor data entry in kW
    NEMA [60 Hz / hp]: Line frequency 60 Hz, motor data entry in hp
11. Under **Supply voltage:** enter the appropriate voltage of the cabinet unit.
12. Click **Continue >**.

Configuring the Motor and Selecting the Motor Type

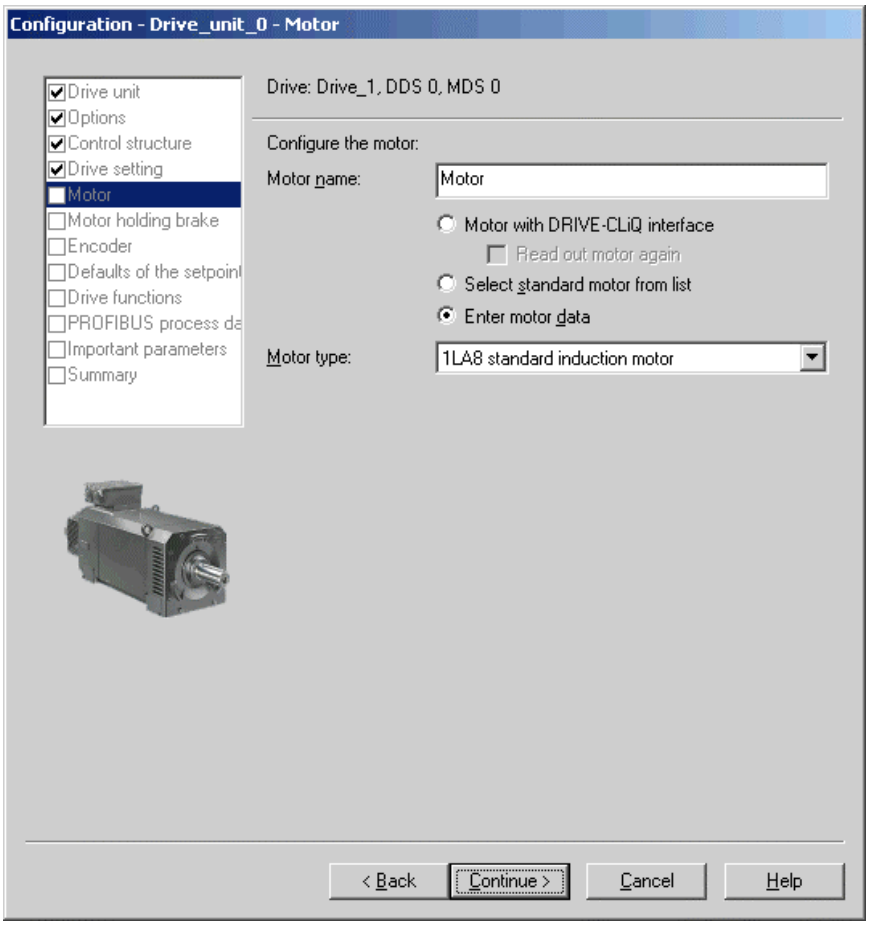


Fig. 5-16 Configuring the motor and selecting the motor type

13. In **Name:**, enter a name for the motor.
14. In the selection field next to **Motor type:**, select the appropriate motor for your application.
15. Click **Continue >**

Configuring the Motor and Entering Motor Data

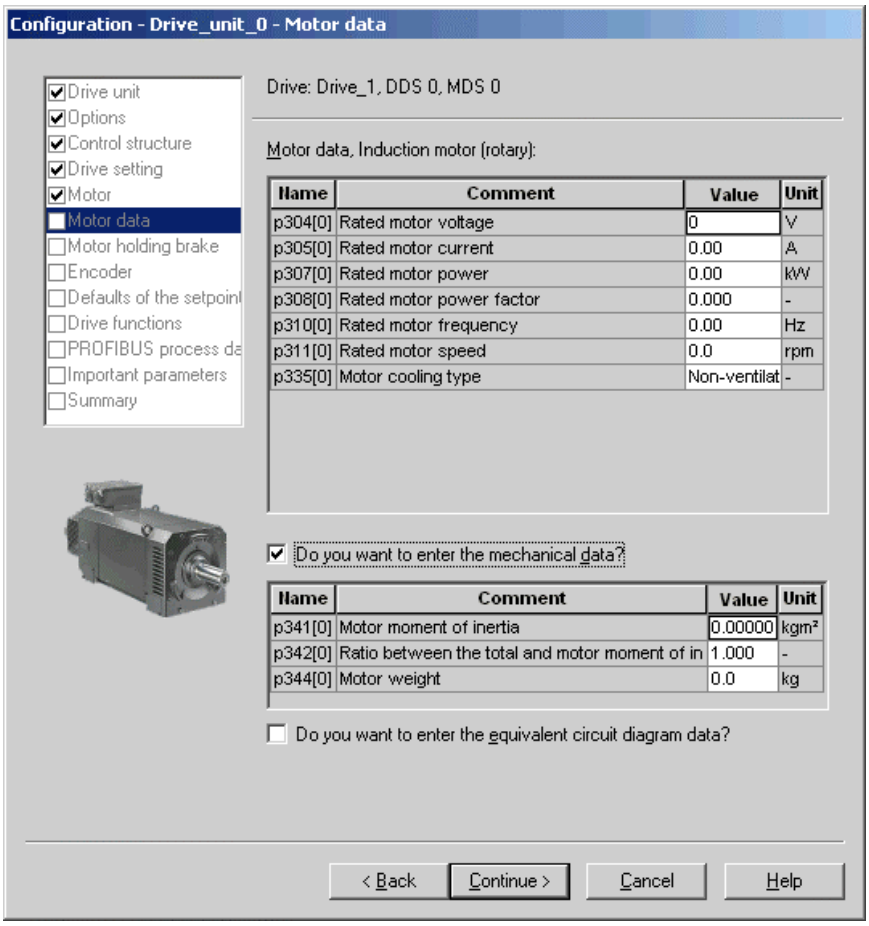

Configuration - Drive_unit_0 - Motor data
Drive unit
Options
Control structure
Drive setting
Motor
Motor data
Motor holding brake
Encoder
Defaults of the setpoint
Drive functions
PROFIBUS process da
Important parameters
Summary
Drive: Drive_1, DDS 0, MDS 0
Motor data, Induction motor (rotary):
Name Comment Value Unit
p304[0] Rated motor voltage 0 V
p305[0] Rated motor current 0.00 A
p307[0] Rated motor power 0.00 kW
p308[0] Rated motor power factor 0.000 -
p310[0] Rated motor frequency 0.00 Hz
p311[0] Rated motor speed 0.0 rpm
p335[0] Motor cooling type Non-ventilat -
Do you want to enter the mechanical data?
Name Comment Value Unit
p341[0] Motor moment of inertia 0.00000 kgm²
p342[0] Ratio between the total and motor moment of in 1.000 -
p344[0] Motor weight 0.0 kg
Do you want to enter the equivalent circuit diagram data?
< Back
Continue >
Cancel
Help

Fig. 5-17 Configuring the motor and entering motor data

16. Enter the motor data (see motor type plate).
17. If necessary, activate **Do you want to enter mechanical data?**.
18. If necessary, activate **Do you want to enter the equivalent circuit diagram data?**.

IMPORTANT
This function should only be activated if the data sheet for equivalent circuit diagram data is available. If any data is missing, an error message will be output when the system attempts to load the drive project to the target system.

Configuring the Motor and Entering Equivalent Circuit Diagram Data

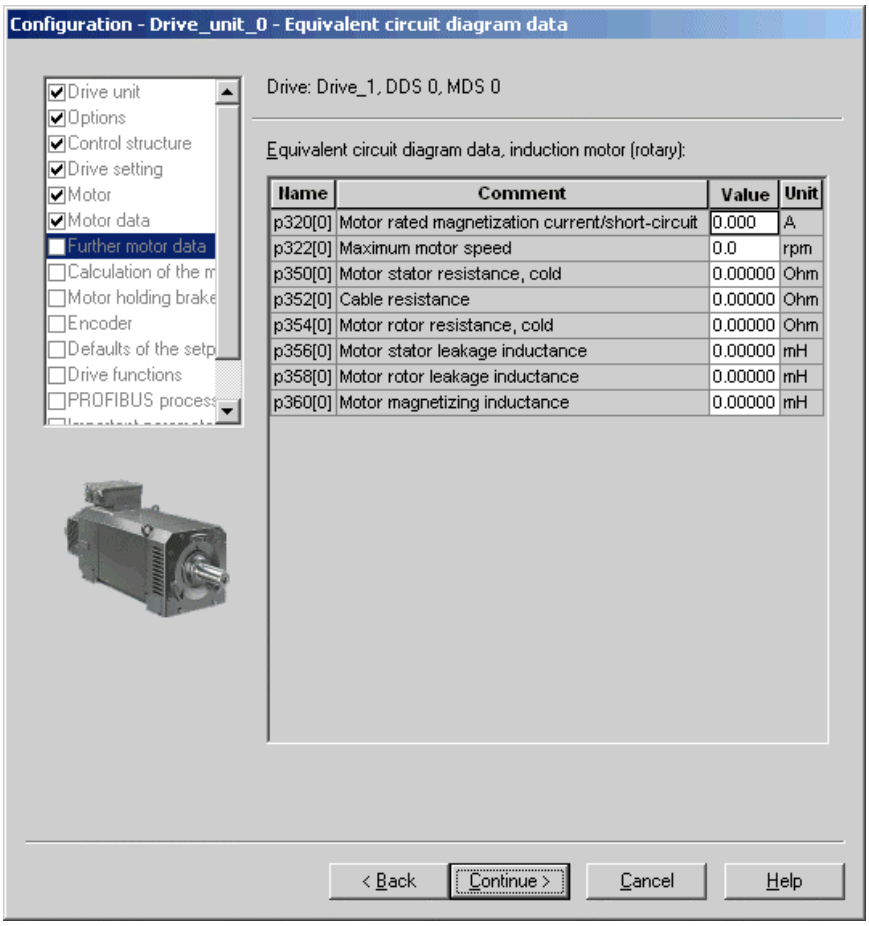


Fig. 5-18 Entering equivalent diagram data

19. If necessary, enter the equivalent circuit diagram data.
20. Click **Continue >**.

Calculating the Motor/Controller Data

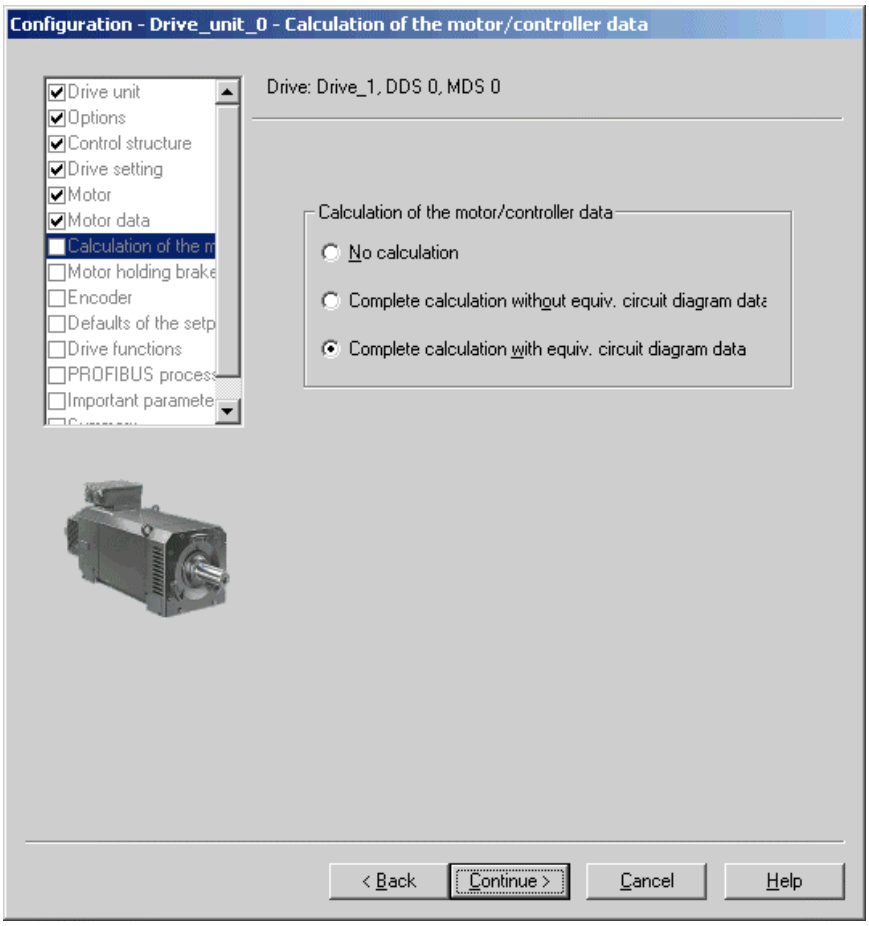


Fig. 5-19 Calculating the motor/controller data

21. In **Calculate the motor/controller data:**, choose the appropriate settings for your device configuration.

NOTE

If the equivalent circuit diagram data was entered manually (see Fig. 5-18), the motor/controller data should be calculated **without** calculating the equivalent circuit diagram data.

Configuring the Motor Holding Brake

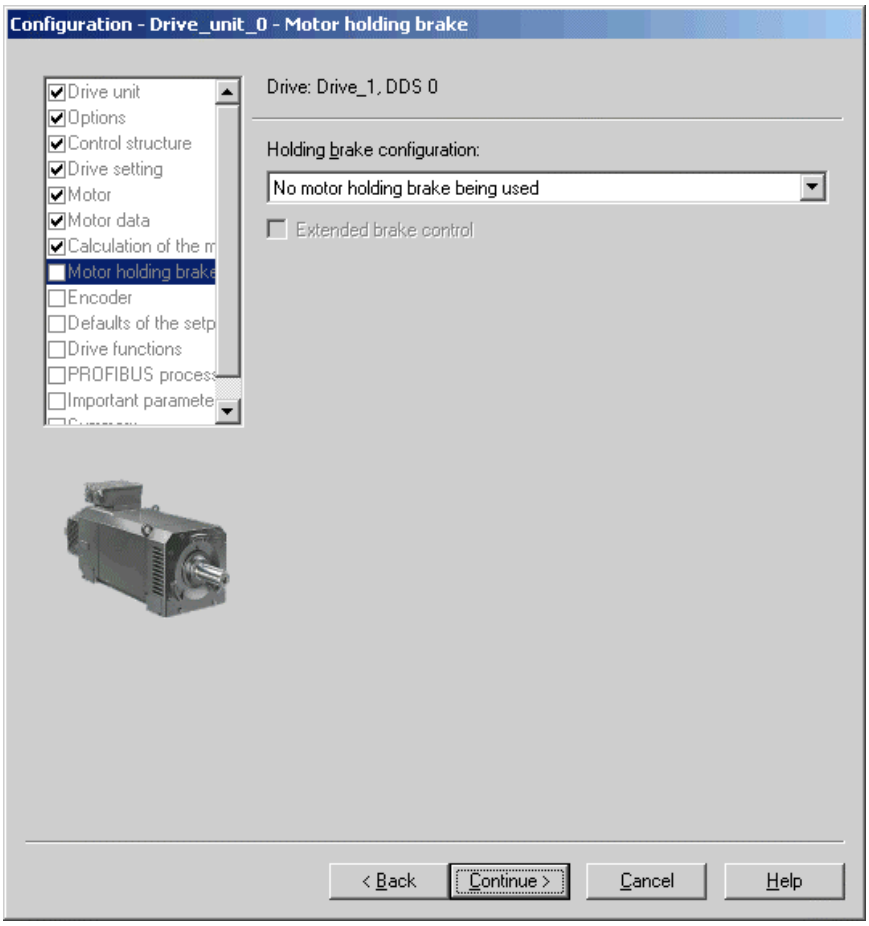


Fig. 5-20 Configuring the motor holding brake

22. In **Holding brake configuration:**, select the appropriate setting for your device configuration.

Entering the Encoder Data (Option K50)

NOTE

If you have specified option K50 (SMC30 sensor module), the following screen is displayed in which you can enter the encoder data.

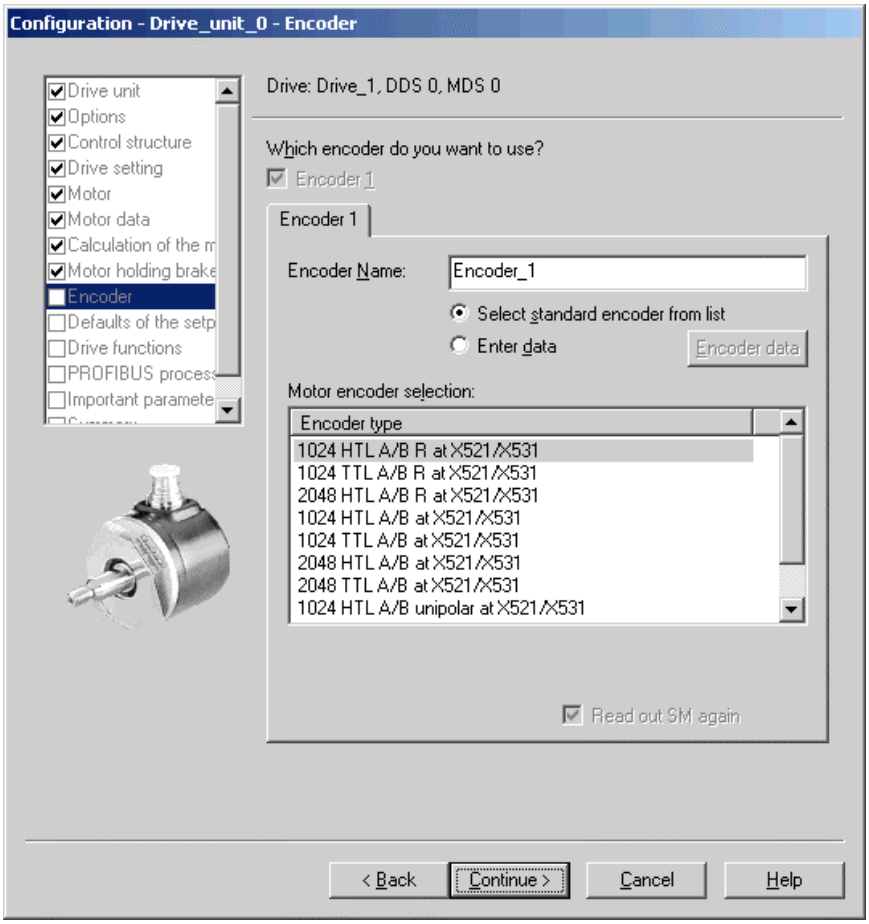


Fig. 5-21 Entering the encoder data

23. In **Name:**, enter a name.

NOTE

In the factory setting, an HTL encoder is bipolar with 1024 pulses per revolution at terminal X521/X531.

24. Click the option field **Select standard encoder from list** and select one of the available encoders.
25. To enter special encoder configurations, click the option field **Enter data** and then **Encoder data**. The following screen is displayed in which you can enter the required data.

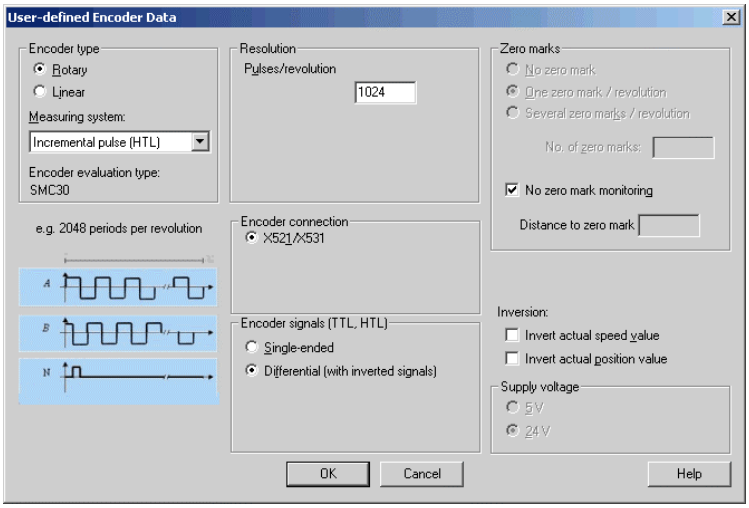


Fig. 5-22 Entering the encoder data – user-defined encoder data – HTL encoder

26. Select the **measuring system**.
    You can choose the following encoders:
    - HTL
    - TTL

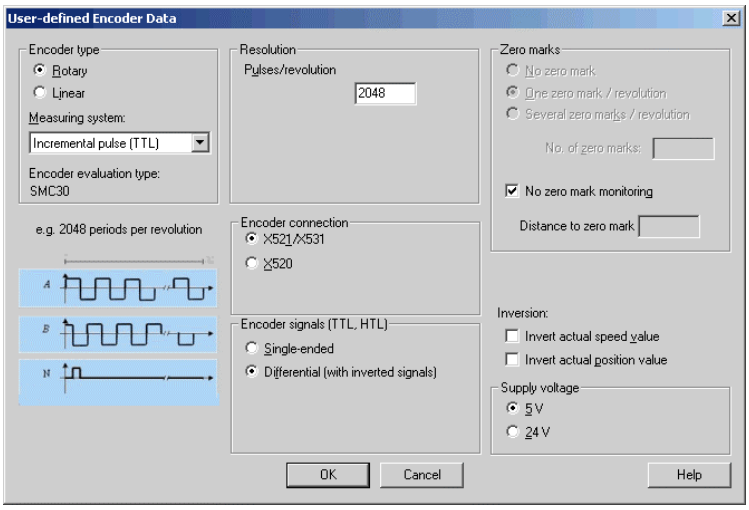


Fig. 5-23 Entering the encoder data – user-defined encoder data – TTL encoder

27. Enter the required encoder data.
28. Click **OK**.

CAUTION

Once the encoder has been commissioned, the supply voltage (5/24 V) set for the encoder is activated on the SMC30 module. If a 5 V encoder is connected and the supply voltage has not been set correctly, the encoder may be damaged.

Default Settings for Setpoints / Command Sources

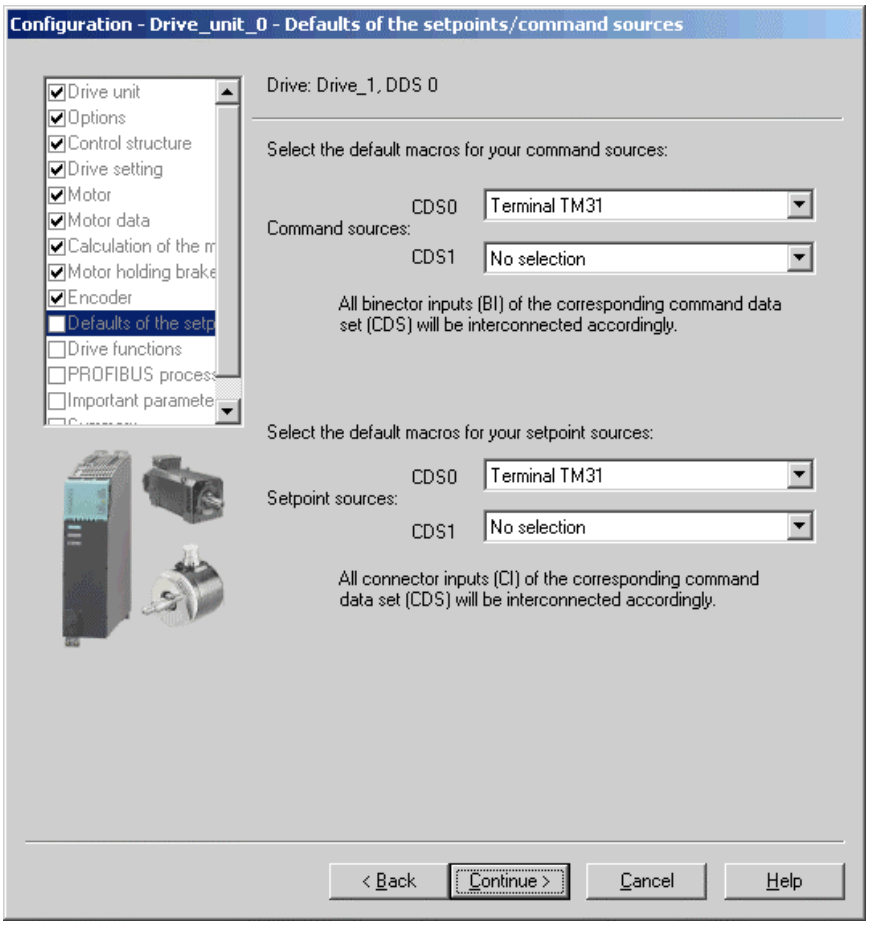


Fig. 5-24 Default settings for setpoints / command sources

29. In **Command sources:** and **Setpoint sources:**, choose the appropriate settings for your device configuration.
    The following command and setpoint source options are available:

Command Sources

- PROFIBUS
- TM31 terminals
- NAMUR
- PROFIdrive NAMUR

Setpoint Sources

- PROFIBUS
- TM31 terminals
- Motorized potentiometer
- Fixed setpoint

NOTE
With SINAMICS G150, only CDS0 is normally used as a default setting for the command and setpoint sources.
Make sure that the selected default settings are compatible with the actual system configuration.
You cannot use the **< Back** pushbutton if you want to change the default settings (unless **No selection** is displayed for the current value).
If you have made an incorrect entry, you have to delete the entire drive unit from the project navigator and add a new one.

30. Carefully check the default settings and then click **Continue >**.

Technological Application / Defining the Motor Identification

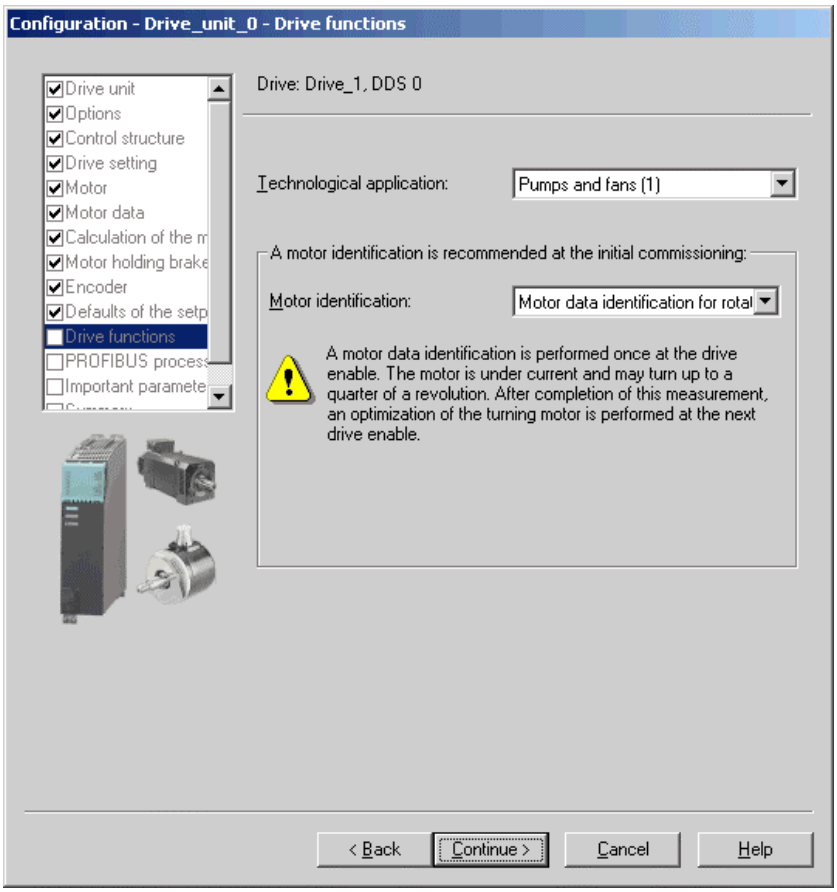

Configuration - Drive_unit_0 - Drive functions
Drive unit
Options
Control structure
Drive setting
Motor
Motor data
Calculation of the m
Motor holding brake
Encoder
Defaults of the setp
Drive functions
PROFIBUS process
Important paramete
Drive: Drive_1, DDS 0
Technological application:
Pumps and fans (1)
A motor identification is recommended at the initial commissioning:
Motor identification:
Motor data identification for rotat
A motor data identification is performed once at the drive enable. The motor is under current and may turn up to a quarter of a revolution. After completion of this measurement, an optimization of the turning motor is performed at the next drive enable.
< Back
Continue >
Cancel
Help

Fig. 5-25 Technological application / defining the motor identification

31. Select the required data:
    - Technological application:
      "Pumps and fans": edge modulation is enabled (default setting)
      "Standard drive (VECTOR)": edge modulation is not enabled.
    - Motor identification:
      In most cases, "Motor data identification for rotating motor" is the correct default setting for SINAMICS G150.
32. Click **Continue >**.

Selecting the PROFIBUS Telegram

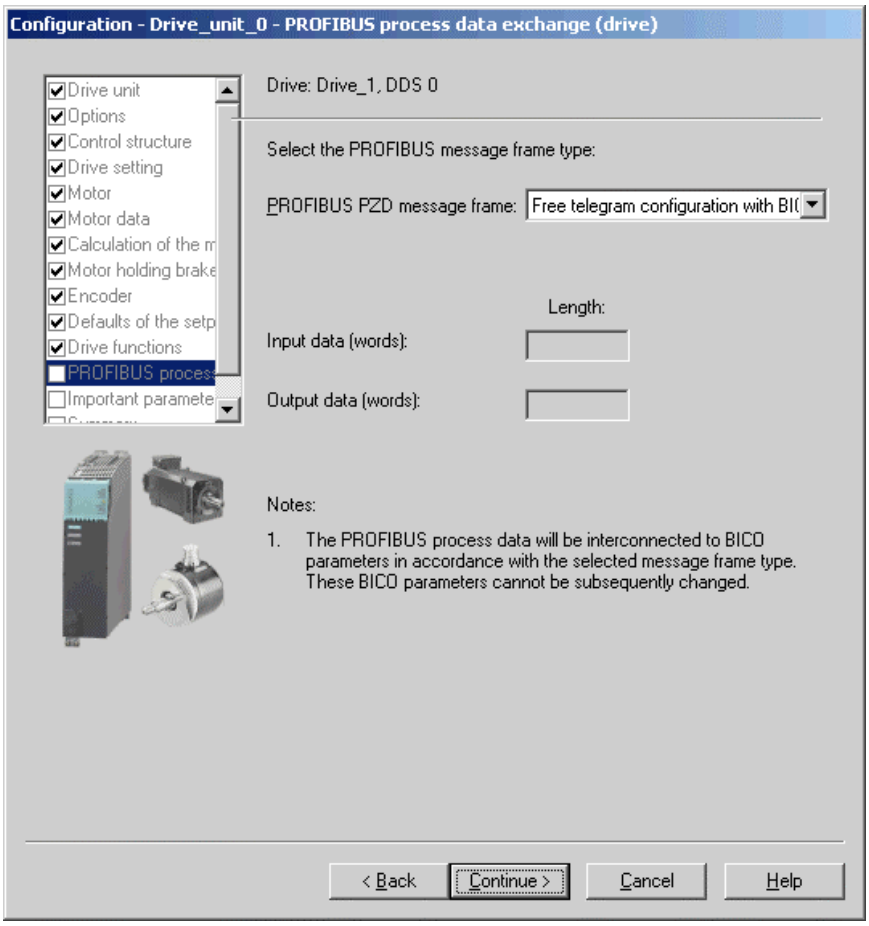


Fig. 5-26 Selecting the PROFIBUS telegram

33. Under **PROFIBUS PZD telegram, select:** the PROFIBUS telegram type.

    Telegram types
    - Standard telegram 1
    - VIK-NAMUR telegram 20
    - PCS7 telegram 352
    - Free telegram configuration with BICO

34. Click **Continue >**.

Entering Key Parameters

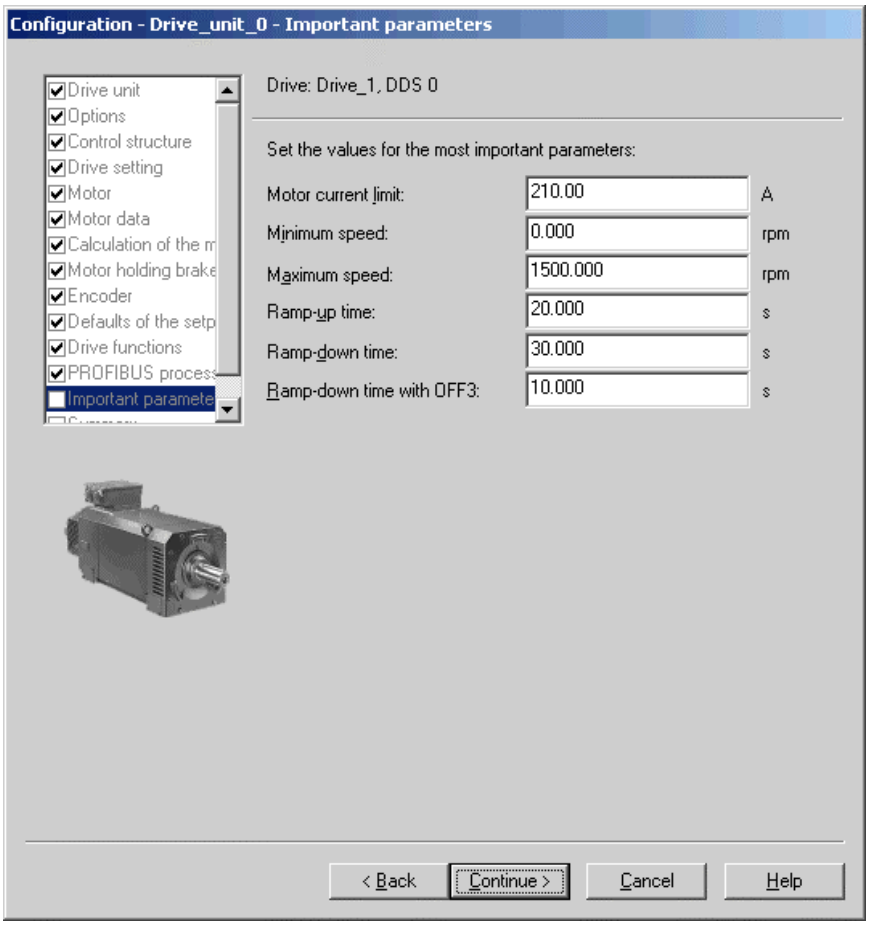


Fig. 5-27 Key parameters

35. Enter the required parameter values.

NOTE

STARTER provides tool tips if you position your cursor on the required field **without clicking in the field**.

36. Click **Continue >**.

Summary of the Drive Unit Data

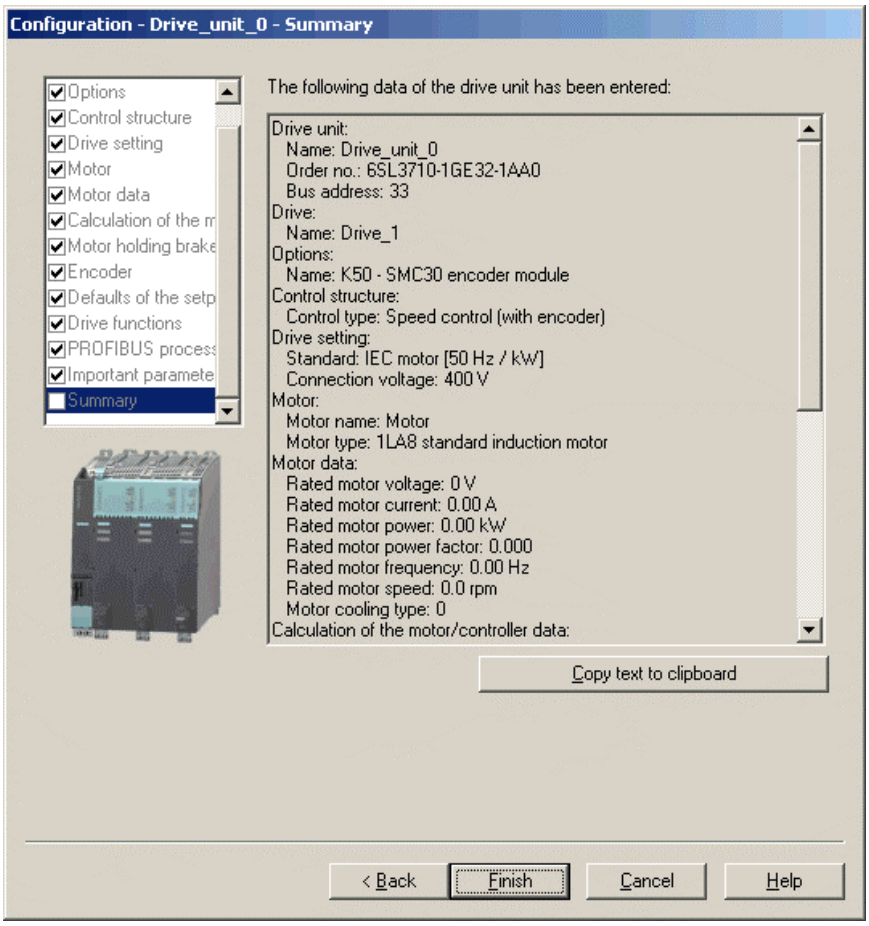


Fig. 5-28 Summary of the drive unit data

37. You can use the **Copy** function to copy the summary of the drive unit data displayed on the screen to a word processing program for subsequent use.
38. Click **Finish**.
39. Save your project to the hard disk by choosing **Project > Save**.

5.3.3 Additional and necessary settings for cabinet units with a high power rating

After commissioning the drive units using STARTER, for the following cabinet units, additional settings must be made:

- for 3-ph. 380 V – 480 V AC:
  6SL3710-2GE41-1AA0, 6SL3710-2GE41-4AA0, 6SL3710-2GE41-6AA0
- for 3-ph. 500 V – 600 V AC:
  6SL3710-2GF38-6AA0, 6SL3710-2GF41-1AA0, 6SL3710-2GF41-4AA0
- for 3-ph. 660 V – 690 V AC:
  6SL3710-2GH41-1AA0, 6SL3710-2GH41-4AA0, 6SL3710-2GH41-5AA0

Settings to monitor the feedback signal from the main contactor or circuit-breaker for 12-pulse infeed and connected DC link

The feedback signal contacts of the main contactors and the circuit-breakers are connected in series in the factory and are connected to digital input 7 of the Control Unit.

After the drive unit has been commissioned, the feedback signal monitoring function must be activated. This is realized using parameter p0860{Vector} = 722.7{Control_Unit}.

DANGER

If you do not activate the monitoring function of the feedback signal of the main contactors or the circuit-breaker, then the drive can be powered-up even if the main contactor or circuit-breaker fails. In this case, the incoming rectifier of a cabinet unit or the DC link connections could be damaged.

NOTICE

When resetting (restoring) the parameterization to the factory setting, this setting must be again made after the drive unit has been re-commissioned.

Settings for a 12-pulse infeed and connected to a motor with a one-winding system

During commissioning, a motor with several winding systems is automatically defined.

The setting for a single-winding system is made after commissioning has been completed by setting parameter p7003 to 0.

NOTICE

If the "motor with a one-winding system" is not set using p7003 = 0, then the drive is powered-down (tripped) during motor identification routine with an "overcurrent" fault message.

NOTICE

When resetting (restoring) the parameterization to the factory setting, this setting must be again made after the drive unit has been re-commissioned.

5.3.4 Starting the Drive Project

You have created a project and saved it to your hard disk. You now have to transfer your project configuration data to the drive unit.

Transferring the STARTER Project to the Drive Unit

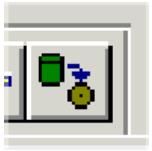
To transfer the STARTER project you created offline to the drive unit, carry out the following steps:

Step	Selection in toolbar
1. Choose **Project > Connect to target system**.	
2. Choose **Target system > Load project to target system**.	

IMPORTANT

The project has now been loaded to the drive unit. The data is currently only stored in the volatile memory of the drive unit and not on the CompactFlash card.

To store the project data on the CompactFlash card so that it is protected in the event of a power failure, carry out the following step.

Step	Selection in toolbar
3. Choose **Target system > Copy from RAM to ROM**.	

NOTE

The **Copy from RAM to ROM** icon is only active when the drive unit is selected in the project navigator.

Results of the Previous Steps

- You have created a drive unit project offline using STARTER.
- You have saved the project data to the hard disk on your PC.
- You have transferred the project data to the drive unit.
- You have saved the project data to the CompactFlash card so that it is protected in the event of a power failure.

NOTE

The STARTER commissioning tool supports complex drive system operations.

If you are confronted with any system conditions in online mode that are beyond your control, you are advised to delete the drive project from the project navigator and carefully create a new project in STARTER using the appropriate configuration data for your application.

5.4 The Operator Panel (AOP30)

Description

An operator panel is located in the cabinet door of the cabinet unit for operating, monitoring, and commissioning tasks. It has the following features:

- Graphical LCD with backlighting for plain-text display and a "bar display" of process variables
- LEDs for displaying the operational statuses
- Help function describing causes of and remedies for faults and alarms
- Keypad for controlling drives during operation
- LOCAL/REMOTE switchover for selecting the control terminal (master control assigned to operator panel or customer terminal block / PROFIBUS)
- Numeric keypad for entering setpoint or parameter values
- Function keys for prompted navigation through the menus
- Two-stage security concept to protect against accidental or unauthorized changes to settings
- Degree of protection IP 54 (when installed)

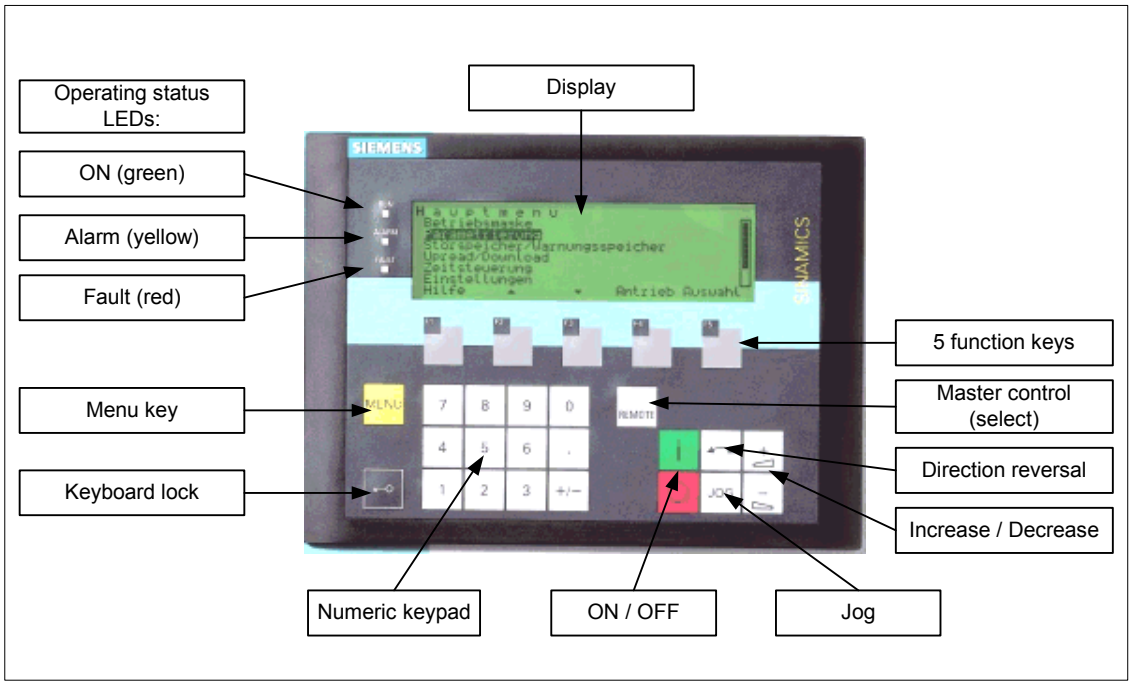


Fig. 5-29 Components of the cabinet operator panel

5.5 Initial Commissioning

5.5.1 Initial Ramp-Up

Start Screen

When the system is switched on for the first time, the control unit (CPU) is initialized automatically. The following screen is displayed:

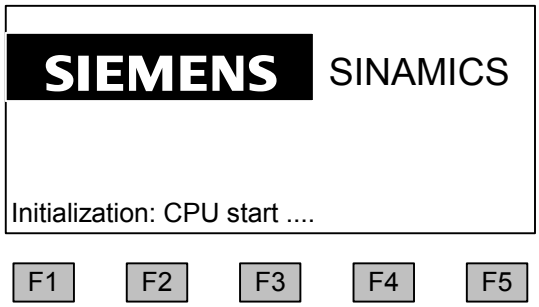


Fig. 5-30 Initial screen

While the system is ramping up, the internal statuses are displayed in the bottom line of the operator panel.

Topology Display

When the cabinet unit is ramped up for the first time or reset to the factory setting, a screen appears for you to confirm the topology determined.

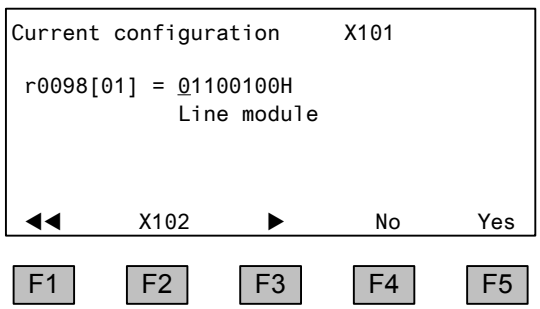


Fig. 5-31 Confirming the topology (example)

After a few seconds, the system automatically exits the screen and the ramp-up is continued.

Once the system has successfully ramped up, the drive has to be commissioned when the system is switched on for the first time after it has been delivered. The converter can then be switched on.

When the system is then ramped up again, it can be operated immediately.

5.5.2 Basic Commissioning

Entering the Motor Data

During initial commissioning, you have to enter motor data using the operator panel. Use the data shown on the motor type plate.

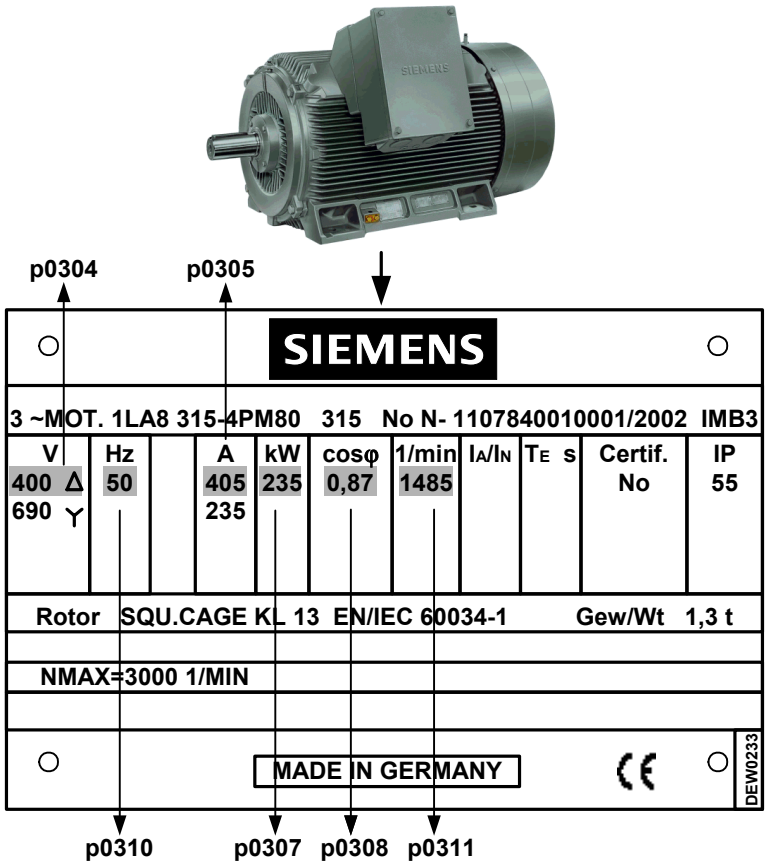


Fig. 5-32 Example of a motor type plate

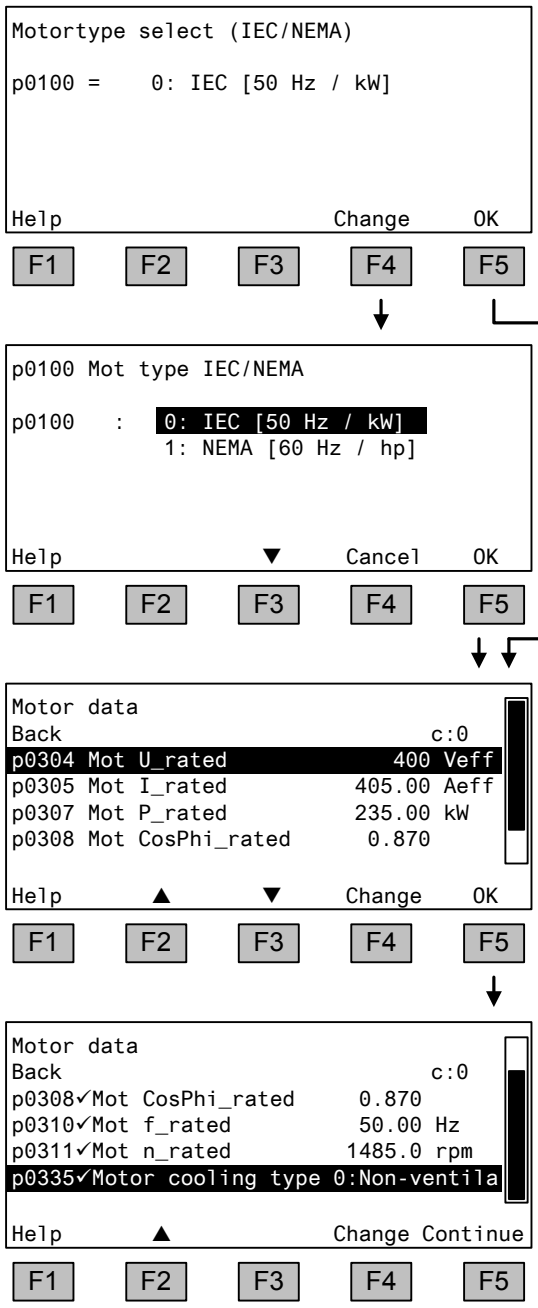
Table 5-1 Motor data

	Parameter no.	Values	Unit
System of units for line frequency and entering motor data	p0100	0 1	IEC [50 Hz / kW] NEMA [60 Hz / hp]
Motor:			
Rated voltage	p0304		[V]
Rated current	p0305		[A]
Rated output	p0307		[kW] / [hp]
Rated power factor Cos φ (at p0100 = 0 only)	p0308		
Rated efficiency φ (at p0100 = 1 only)	p0309		[%]
Rated frequency	p0310		[Hz]
Rated speed	p0311		[min-1] / [rpm]

Basic Commissioning: Selecting the Motor Type and Entering the Motor Data

For the following cabinet units, possible additional settings must be made before the following sequence (refer to Chapter 5.5.3):

- for 3-ph. 380 V – 480 V AC:
  6SL3710-2GE41-1AA0, 6SL3710-2GE41-4AA0, 6SL3710-2GE41-6AA0
- for 3-ph. 500 V – 600 V AC:
  6SL3710-2GF38-6AA0, 6SL3710-2GF41-1AA0, 6SL3710-2GF41-4AA0
- for 3-ph. 660 V – 690 V AC:
  6SL3710-2GH41-1AA0, 6SL3710-2GH41-4AA0, 6SL3710-2GH41-5AA0


Motortype select (IEC/NEMA)
p0100 = 0: IEC [50 Hz / kW]
Help Change OK
F1 F2 F3 F4 F5
p0100 Mot type IEC/NEMA
p0100 : 0: IEC [50 Hz / kW]
1: NEMA [60 Hz / hp]
Help ▼ Cancel OK
F1 F2 F3 F4 F5
Motor data
Back c:0
p0304 Mot U_rated 400 Veff
p0305 Mot I_rated 405.00 Aeff
p0307 Mot P_rated 235.00 kW
p0308 Mot CosPhi_rated 0.870
Help ▲ ▼ Change OK
F1 F2 F3 F4 F5
Motor data
Back c:0
p0308✓Mot CosPhi_rated 0.870
p0310✓Mot f_rated 50.00 Hz
p0311✓Mot n_rated 1485.0 rpm
p0335✓Motor cooling type 0:Non-ventila
Help ▲ Change Continue
F1 F2 F3 F4 F5

Dialog screen for selecting the line frequency and motor data in kW or hp.

Change the values with <F4>
Confirm the values with <F5>

The following is defined:
0: line frequency 50 Hz, motor data in kW
1: line frequency 60 Hz, motor data in hp

To select the setting options, choose <F2> or <F3>.

To abort the motor selection, choose <F4>.
To confirm the settings, choose <F5>.

Entering motor data specified on the type plate

Change the values with <F4>:
A screen is displayed in which you can enter the relevant values.
To return to the previous dialog screen, choose <back>.

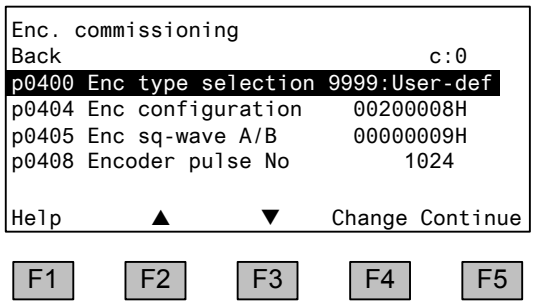
When you set the values, they must each be confirmed with <F5>. A checkmark ✓ next to the parameter number indicates that the corresponding value has been confirmed.

Once you have set and confirmed all the values, press <F5> to continue with basic commissioning.

NOTE
To ensure that you can continue with basic commissioning, you must confirm each parameter in this screen individually.

Fig. 5-33 Selecting the motor type and entering the motor data

Basic Commissioning: Entering the Encoder Data (if available)



If the SMC30 encoder evaluation module is connected, this is recognized by the AOP30 and a screen is displayed in which you can enter the encoder data.

Change the values with <F4>
Confirm the values with <F5>

The bit settings for p0404 indicate the following:

Bit	Meaning	Value 0	Value 1
20	Voltage level 5 V	No	Yes
21	Voltage level 24 V	No	Yes

The bit settings for p0404 indicate the following:

Bit	Meaning	Value 0	Value 1
0	Signal	Unipolar	Bipolar
1	Level	HTL	TTL
2	Track monitoring	None	A/B<> -A/B
3	Zero pulse	24 V unip.	As A/B track

Fig. 5-34 Entering the encoder data (if available)

NOTE

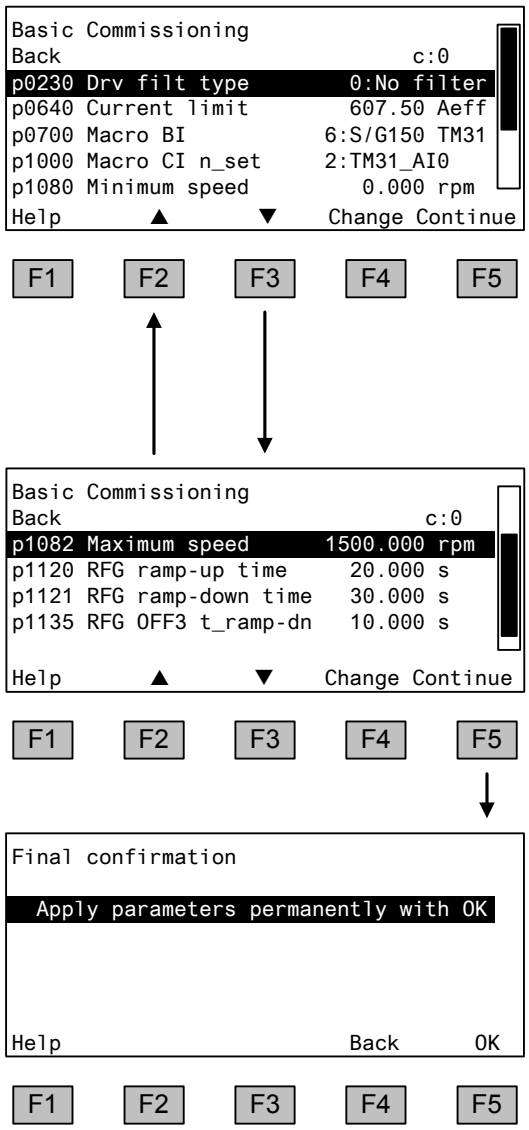
In the factory setting, an HTL encoder is bipolar with 1024 pulses per revolution and a 24 V power supply.

Chapter 4 ("Electrical Installation") contains two connection examples for HTL and TTL encoders.

CAUTION

Once the encoder has been commissioned, the supply voltage (5/24 V) set for the encoder is activated on the SMC30 module. If a 5 V encoder is connected and the supply voltage has not been set correctly via p0404 (bit 20 = "Yes", bit 21 = "No"), the encoder may be damaged.

Basic Commissioning: Entering the Basic Parameters


Basic Commissioning
Back c:0
p0230 Drv filt type 0:No filter
p0640 Current limit 607.50 Aeff
p0700 Macro BI 6:S/G150 TM31
p1000 Macro CI n_set 2:TM31_AI0
p1080 Minimum speed 0.000 rpm
Help ▲ ▼ Change Continue
F1 F2 F3 F4 F5
Basic Commissioning
Back c:0
p1082 Maximum speed 1500.000 rpm
p1120 RFG ramp-up time 20.000 s
p1121 RFG ramp-down time 30.000 s
p1135 RFG OFF3 t_ramp-dn 10.000 s
Help ▲ ▼ Change Continue
F1 F2 F3 F4 F5
Final confirmation
Apply parameters permanently with OK
Help Back OK
F1 F2 F3 F4 F5

Entering the basic commissioning parameters

If a sinusoidal filter (option L15) is connected, then it must be activated in p0230. Otherwise the filter could be destroyed.

p0700: Default command source setting
- 5: S/G150 PROFIBUS
- 6: S/G150 TM31
- 7: S/G150 NAMUR
- 10: S/G150 PROFIdrive NAMUR

p1000: Default setpoint source setting
- 1: PROFIBUS
- 2: TM31_AI0
- 3: Motorpoti
- 4: Fixed setpoint

To select the basic parameters, choose <F3> and <F2>.

Change the values with <F4>:
A screen is displayed in which you can enter the relevant values

To continue, choose <F5>

Final confirmation

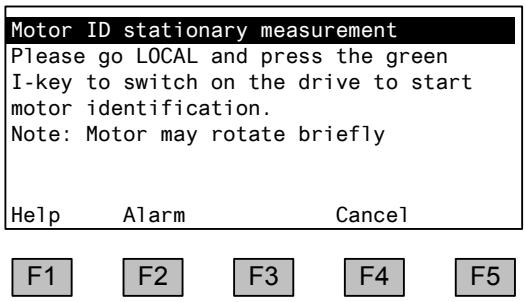
Confirm the basic parameters you have entered to save them.

To return to the previous dialog screen, choose <Back>.
To continue, choose <F5>.

The basic parameters you have entered are saved permanently and the required calculations for closed-loop control are made.

Fig. 5-35 Basic commissioning – Entering the Basic Parameters

Basic Commissioning: Motor Identification

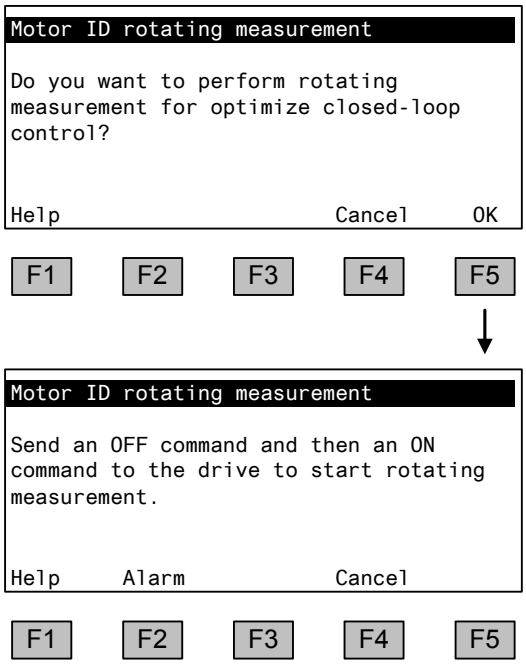


Motor identification: stationary measurement

To switch on the drive, choose LOCAL (wait until the LED in the LOCAL key lights up) and then press the ON key.

If motor identification is aborted with <F4>, motor control uses the characteristic motor values calculated from the type plate data rather than the measured values. The measurement improves control quality because deviations in the electrical characteristic values due to differences between the material properties and manufacturing tolerances are minimized.

NOTE
When motor identification is complete, you must press the OFF key to cancel the power-on inhibit.



Motor identification: rotating measurement

To switch on the drive, choose LOCAL (wait until the LED in the LOCAL key lights up) and then press the ON key.

If motor identification is aborted with <F4>, motor control uses the characteristic motor values calculated from the type plate data rather than the measured values.

The rotating measurement determines the data required (e.g. moment of inertia) for setting the speed controller. It also measures the magnetization characteristic and rated magnetization current of the motor.

NOTE
When motor identification is complete, you must press the OFF key to cancel the power-on inhibit.

Fig. 5-36 Basic commissioning – Rotating Measurement

DANGER

During the rotating measurement, the drive triggers movements in the motor that can reach the maximum motor speed. The emergency OFF functions must be fully operational during commissioning. To protect the machines and personnel, the relevant safety regulations must be observed.

5.5.3 Additional and necessary settings for cabinet units with a high power rating

Additional settings must be made for the following cabinet units before selecting the motor and entering the motor data via the operator panel:

- for 3-ph. 380 V – 480 V AC:
  6SL3710-2GE41-1AA0, 6SL3710-2GE41-4AA0, 6SL3710-2GE41-6AA0
- for 3-ph. 500 V – 600 V AC:
  6SL3710-2GF38-6AA0, 6SL3710-2GF41-1AA0, 6SL3710-2GF41-4AA0
- for 3-ph. 660 V – 690 V AC:
  6SL3710-2GH41-1AA0, 6SL3710-2GH41-4AA0, 6SL3710-2GH41-5AA0

Settings to monitor the feedback signal from the main contactor or circuit-breaker for 12-pulse infeed and connected DC link

The feedback signal contacts of the main contactors and the circuit-breakers are connected in series in the factory and connected to digital input 7 of the CU320 Control Unit.

After the drive unit has been commissioned, the feedback signal monitoring function must be activated. This is realized using parameter p0860{Vector} = 722.7{Control_Unit}.

Settings via the AOP30

p0860 = r0722.7

Select parameter p0860 "Line contactor feedback signal" and connect to digital input DI7
<MENU> <Parameter> <All parameters> <Selection> select
"p0860" <change> select "{01:CU}" <OK>
<Key F2> <Key F2> <Key F3> <OK>
"select r0722" <OK>
"select .07 DI 7 (X132.4)" <OK>

DANGER

If you do not activate the monitoring function of the feedback signal of the main contactors or the circuit-breaker, then the drive can be powered-up even if the main contactor or circuit-breaker fails. In this case, the incoming rectifier of a cabinet unit or the DC link connections could be damaged.

NOTICE

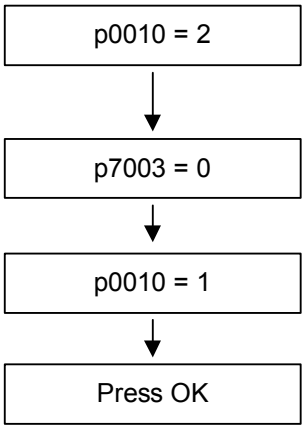
When resetting (restoring) the parameterization to the factory setting, this setting must be again made after the drive unit has been re-commissioned.

Settings for a 12-pulse infeed and connected to a motor with a one-winding system

Before the commissioning, a motor with several winding systems is automatically defined.

The setting for a single-winding system is made before commissioning by setting parameter p7003 to 0.

Settings via the AOP30



Set the drive commissioning filter to "Power unit commissioning"
<MENU> <Parameter> <All parameters> <Selection> "p0010" <change>set "2" <OK>

Set the winding system to "One winding"
"p7003" <change> set "0" <OK>

Set the drive commissioning filter to "Quick commissioning"
"p0010" <change> set "1" <OK>

Continue drive commissioning menu
<MENU> <Drive commissioning> <Selection>

NOTICE

If the "motor with a one-winding system" is not set using p7003 = 0, then the drive is powered-down (tripped) during motor identification routine with an "overcurrent" fault message.

NOTICE

When resetting (restoring) the parameterization to the factory setting, this setting must be again made before the drive unit is re-commissioned.

5.6 Status After Commissioning

LOCAL Mode (Control via Operator Panel)

- You switch to LOCAL mode by pressing the "LOCAL/REMOTE" key.
- Control (ON/OFF) is carried out via the "ON" and "OFF" keys.
- You specify the setpoint using the "increase" and "decrease" keys or by entering the appropriate numbers using the numeric keypad.

Analog outputs

- The actual speed (r0063) is output as a current output in the range 0 to 20 mA at analog output 0 (X522:2 and 3).
  A current of 20 mA is equal to the maximum speed in p1082.
- The actual current value (r0068) is output as a current output in the range 0 to 20 mA at analog output 1 (X522:5 and 6).
  A current of 20 mA is equal to the current limit (p0640) set to 1.5 x rated motor current (p0305).

Digital outputs

- The "enable pulses" signal is output at digital output 0 (X542:2 and 3).
- The “no fault active” signal is output at digital output 1 (X542:5 and 6) (fail safe).
- The "ready to start" signal is output at digital output 8 (X541:2).

5.7 Data Backup

5.7.1 Saving the CompactFlash Card Parameter Settings

After commissioning, you are advised to store the CompactFlash card data on an external storage medium (hard disk, data media).

To do so, use a card reader connected to a PC. Ensure that all the files and directories are stored in the same form as on the CompactFlash card.

If required, you can restore the device status after the drive has been commissioned by transferring the stored data to the CompactFlash card.

NOTE

You should only remove the CompactFlash card when the system is switched off. If you remove it while the system is switched on, warning A1100 ("CompactFlash Card removed") is output.

5.7.2 Restoring the Saved Configuration

To restore the saved configuration, you have to delete all the files on the CompactFlash card and transfer the saved copy to the CompactFlash card.

IMPORTANT

When you delete the files on the CompactFlash card, the saved drive parameters are permanently lost!

When re-importing the saved files, you must ensure that none of the files in the "User" sub-folder on the CompactFlash card has a write-protection attribute. This can occur, for example, if the copy of the CompactFlash card was stored temporarily on a CD.

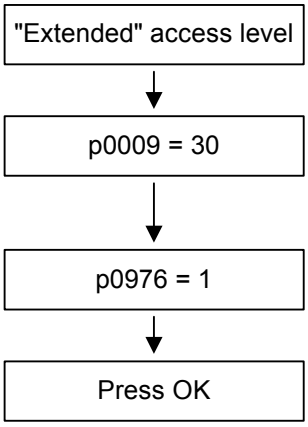
The CompactFlash card directory must be structured in the same way as before. If you move individual files to sub-folders, you may not be able to use the CompactFlash card.

5.8 Resetting Parameters to the Factory Settings

The factory settings represent the defined original status of the cabinet unit on delivery.

Resetting the parameters to the factory settings means that all the parameter settings made since the system was delivered are reset.

Resetting Parameters via AOP30



Setting the " Extended" access level on the operator panel
Set <key pushbutton> - <access level> - <" Extended">.

Setting parameter filter to "parameter reset"
<MENU> <Commissioning/Service> <Device Commissioning> <Selection>
In the next dialog screen, set p0009 = 30

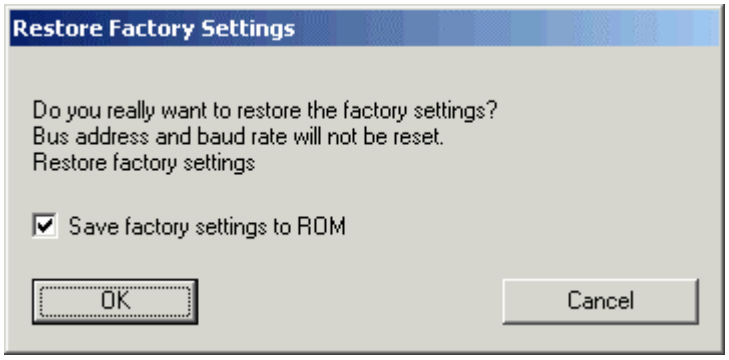
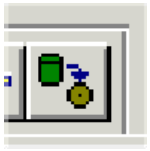
Resetting all the parameters to the factory setting
All the cabinet unit parameters are reset to the SINAMICS G150 factory setting.

Saving the parameters
To set all the parameters to the factory setting and save them on the CompactFlash card, choose F5 "OK". Saving is complete when the message "Being processed..." in the status bar is no longer displayed.

Fig. 5-37 Procedure for resetting parameters to the factory settings with AOP30

Resetting Parameters via STARTER

With STARTER, the parameters are reset in online mode. The required steps are described below:

Step	Selection in toolbar
• Choose **Project > Connect to target system**.	
• Click the drive unit whose parameters you want to reset to the factory settings and click the **Restore factory settings** icon in the toolbar.	
• Click **OK** to confirm this. 	
• Choose **Target system > Copy from RAM to ROM**.	

NOTE

The **Copy from RAM to ROM** icon is only active when the drive unit is selected in the project navigator.

When the parameters have been reset to the factory settings, initial commissioning needs to be carried out.

■

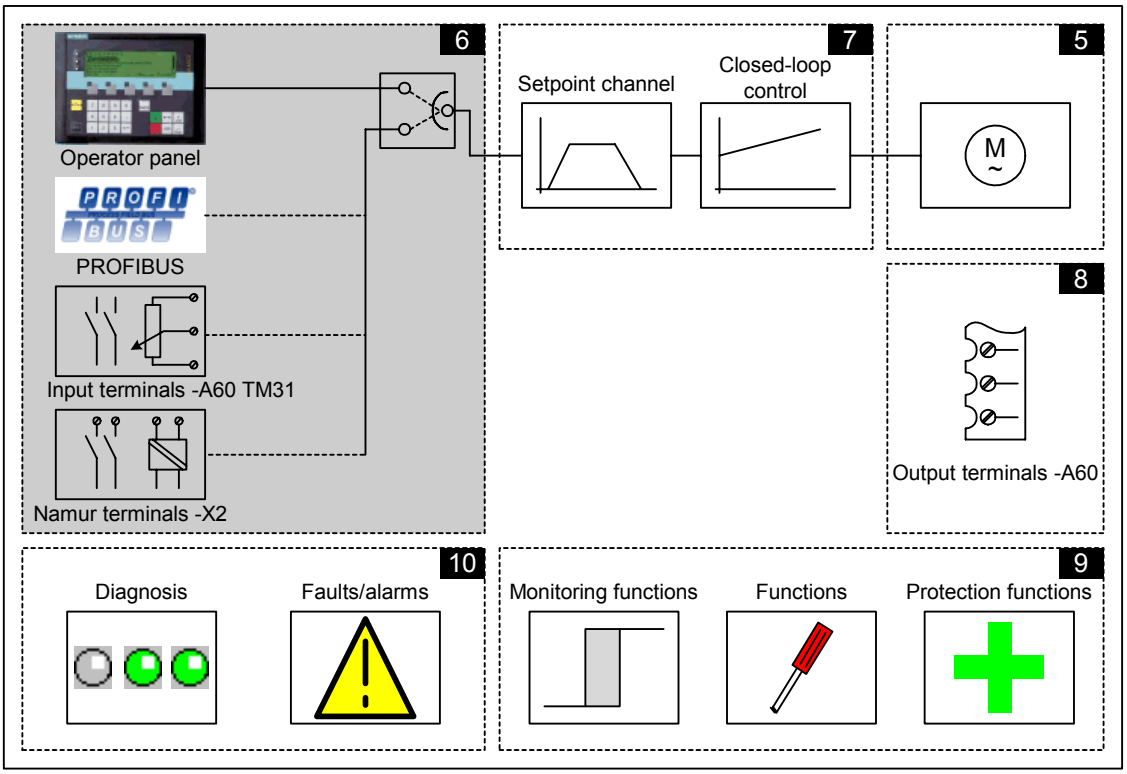
Operation

6

6.1 Chapter Content

This chapter provides information on the following:

- Basic information about the drive system
- Selecting command sources via:
  - PROFIBUS
  - Terminal block
  - NAMUR terminal block
- Inputting setpoints via:
  - PROFIBUS
  - Analog inputs
  - Motorized potentiometer
  - Fixed setpoints
- Control via the AOP30 operator panel



6.2 General Information About Command and Setpoint Sources

Description

Three default settings are available for selecting the command sources and four for selecting the setpoint sources for the SINAMICS G150 cabinet unit.

Command Sources

- PROFIBUS
- TM31 terminals
- NAMUR

Setpoint Sources

- PROFIBUS
- Analog inputs
- Motorized potentiometer
- Fixed setpoints

The various assignments are explained in the following sections.

NOTE

Make sure that the default settings you choose during commissioning are compatible with the cabinet configuration (see "Commissioning", Chapter 5).

Emergency OFF signals (L57, L59, and L60) and motor protection signals (L83 and L84) are always active (regardless of the command source).

Function Diagrams

To supplement this operating manual, the documentation folder contains simplified function diagrams describing the operating principle of the SINAMICS G150. The diagrams are arranged in accordance with the chapters in the operating manual. The page numbers (6xx) describe the functionality in the following chapter.

At certain points in this chapter, reference is made to function diagrams with a 4-digit number. These are stored on the documentation CD in the "SINAMICS G List Manual", which provides experienced users with detailed descriptions of all the functions.

6.3 Basic Information About the Drive System

6.3.1 Parameters

Overview

The drive is adapted to the relevant drive task by means of parameters. Each parameter is identified by a unique parameter number and by specific attributes (e.g. read, write, BICO attribute, group attribute, and so on).

The parameters can be accessed via the following means:

- PC with the "STARTER" commissioning tool via PROFIBUS
- The user-friendly AOP30 Operator Panel

6.3.1.1 Parameter Types

The following adjustable and visualization parameters are available:

- Adjustable parameters (write/read)

  These parameters have a direct impact on the behavior of a function.

  Example: Ramp-up and ramp-down time of a ramp-function generator

- Display parameter (read only)

  These parameters are used to display internal variables.

  Example: current motor current

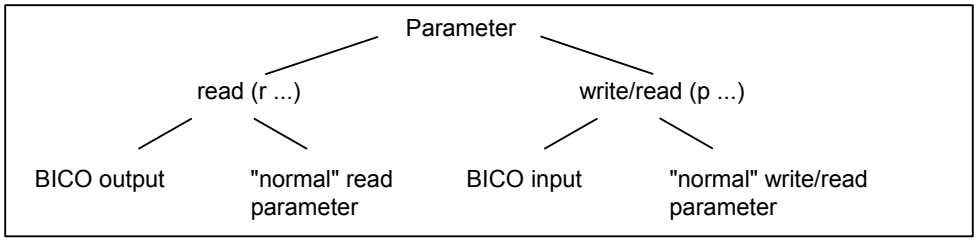


Fig. 6-1 Parameter types

All these drive parameters can be read and changed via PROFIBUS using the mechanisms defined in the PROFIdrive profile.

6.3.1.2 Parameter Categories

The parameters for the individual drive objects (see 6.3.2) are categorized according to data sets as follows (see 6.3.3):

- Data-set-independent parameters

  These parameters exist only once per drive object.

- Data-set-dependent parameters

  These parameters can exist several times for each drive object and can be addressed via the parameter index for reading and writing. A distinction is made between various types of data set:

  - CDS: command data set (CDS)

    By parameterizing several command data sets and switching between them, the drive can be operated with different pre-configured signal sources.

  - DDS: drive data set

    The drive data set contains the parameters for switching between different drive control configurations.

  The CDS and DDS can be switched over during normal operation. Further types of data set also exist, however these can only be activated indirectly by means of a DDS switchover.

  - EDS: encoder data set
  - MDS: motor data set

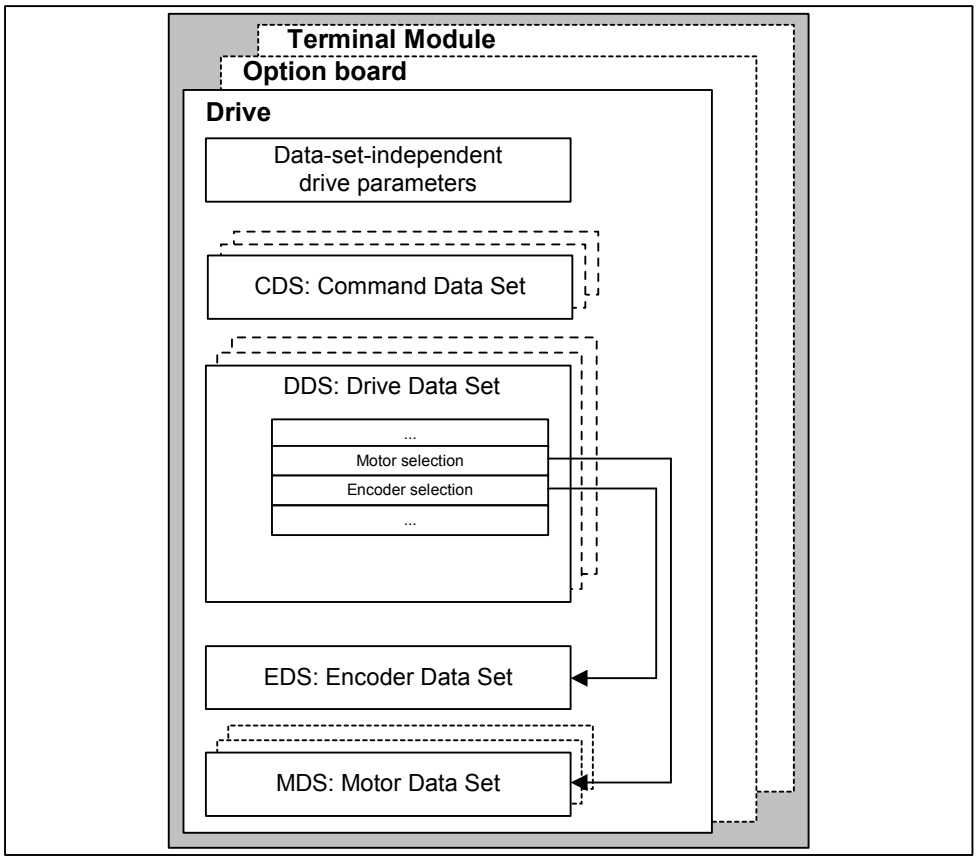


Fig. 6-2 Parameter categories

6.3.2 Drive Objects

A drive object is a self-contained software function with its own parameters and, if necessary, its own faults and alarms. Drive objects can be provided as standard (e.g. I/O evaluation), or you can add single (e.g. option board) or multiple objects (e.g. drive control).

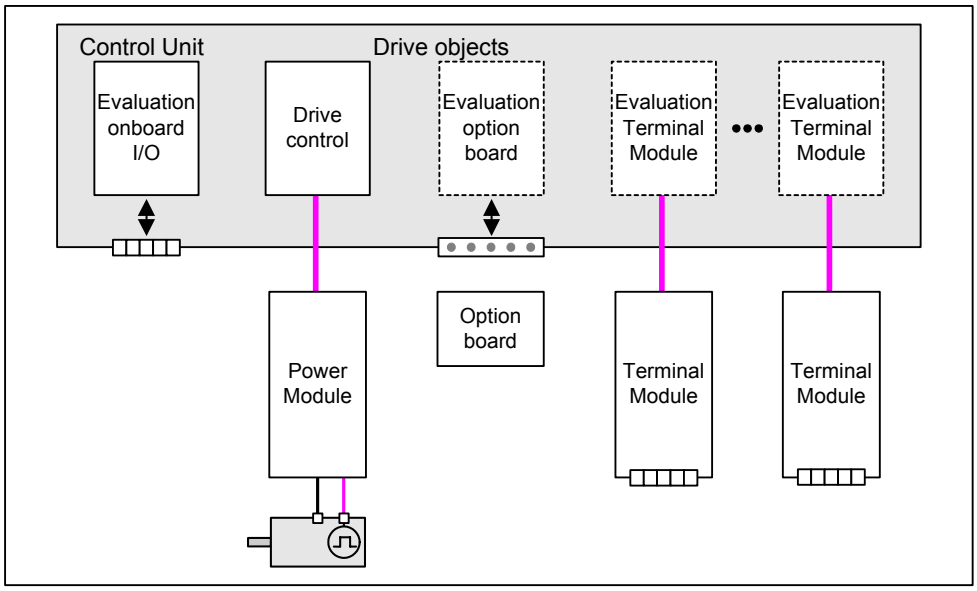


Fig. 6-3 Drive objects

Drive objects installed by default

- Drive control

  Drive control handles closed-loop control of the motor. One power module, at least one motor, and up to three sensors are assigned to drive control.

- Control unit, inputs/outputs

  The I/Os on the control unit are evaluated within a drive object. High-speed inputs for probes are processed here in addition to bidirectional digital I/Os.

Properties of a drive object

- Separate parameter space
- Separate window in STARTER
- Separate fault/alarm system
- Separate PROFIBUS telegram for process data

Optionally installed drive objects

- Option board evaluation

  A further drive object handles evaluation of an installed option board. The specific method of operation depends on the type of option board installed.

- Terminal module evaluation

  A separate drive object handles evaluation of the respective optional terminal modules.

Configuring Drive Objects

When you commission the system for the first time using the STARTER tool, you will use configuration parameters to set up the software-based "drive objects" which are processed on the control unit. Various drive objects can be created within a control unit.

The drive objects are configurable function blocks and are used to execute specific drive functions. If you need to configure additional drive objects or delete existing ones after initial commissioning, the drive system must be switched to configuration mode.

The parameters of a drive object cannot be accessed until the drive object has been configured and you have switched from configuration mode to parameterization mode.

NOTE

Each installed drive object is allocated a number between 0 and 63 during initial commissioning for unique identification.

Parameters

- p0101 Drive object numbers
- p0107 Drive object type
- p0108 Drive object configuration
- r0102 Number of drive objects

6.3.3 Data Sets

Description

For many applications, it is beneficial if more than one parameter can be changed simultaneously by means of one external signal during operation/when the system is ready for operation.

This can be carried out using indexed parameters, whereby the parameters are grouped together in a data set according to their functionality and indexed. Indexing allows several different settings, which can be activated by switching the data set, to be defined in each parameter.

NOTE

The command and drive data sets can be copied in STARTER (Drive -> Configuration -> "Command data sets" or "Drive data sets" tab).
The displayed command and drive data set can be selected in the appropriate STARTER screens.

CDS: Command Data Set (CDS)

The BICO parameters (binector and connector inputs) are grouped together in a command data set. These parameter are used to interconnect the signal sources of a drive (see 6.3.4).

By parameterizing several command data sets and switching between them, the drive can be operated with different pre-configured signal sources.

A command data set contains the following (examples):

- Binector inputs for control commands (digital signals)
  - ON/OFF, enable signals (p0844, etc.)
  - Jog (p1055, etc.)
- Connector inputs for setpoints (analog signals)
  - Voltage setpoint for V/f control (p1330)
  - Torque limits and scaling factors (p1522, p1523, p1528, p1529)

Two command data sets are available.

The following parameters are available for selecting command data sets and for displaying the currently selected command data set:

Table 6-1 Command data set: selection and display

CDS	Selection Bit 0 p0810	Displays Selected r0836	 Active r0050
0	0	0	0
1	1	1	1

If a command data set, which does not exist, is selected, the current data set remains active.

Example: Switching between command data set 0 and 1

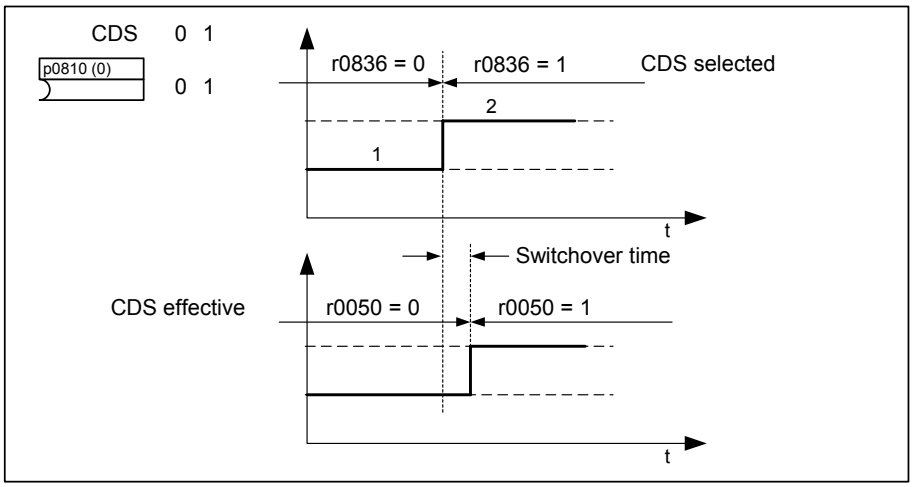


Fig. 6-4 Switching command data sets (example)

DDS: Drive Data Set (CDS)

A drive data set contains various adjustable parameters that are relevant with respect to open and closed-loop drive control:

- Numbers of the assigned motor and encoder data sets:
  - p0186: assigned motor data set (MDS)
  - p0187 to p0189: up to 3 assigned encoder data sets (EDS)
- Various control parameters, e.g.:
  - Fixed speed setpoints (p1001 to p1015)
  - Speed limits min./max. (p1080, p1082)
  - Characteristic data of ramp-function generator (p1120 ff)
  - Characteristic data of controller (p1240 ff)
  - ...

The parameters that are grouped together in the drive data set are identified in the SINAMICS parameter list by "Data Set DDS" and are assigned an index [0..n].

It is possible to parameterize several drive data sets. You can switch easily between different drive configurations (control type, motor, encoder) by selecting the corresponding drive data set.

One drive object can manage up to 32 drive data sets. The number of drive data sets is configured with p0180.

Binector inputs p0820 to p0823 are used to select a drive data set. They represent the number of the drive data set (0 to 31) in binary format (where p0823 is the most significant bit).

- p0820 BI: Command data set selection CDS bit 0
- p0821 BI: Command data set selection CDS bit 1
- p0822 BI: Command data set selection CDS bit 2
- p0823 BI: Command data set selection CDS bit 3

Supplementary conditions and recommendations

- Recommendation for the number of drive data sets for a drive

  The number of drive data sets for a drive should correspond to the options for switchover. The following must therefore apply:

  p0180 (DDS) ≥ p0130 (MDS)
- Max. number of DDS for one drive object = 32 DDS

EDS: Encoder Data Set

An encoder data set contains various adjustable parameters describing the connected encoder for the purpose of configuring the drive.

- Adjustable parameters, e.g.:
  - Encoder interface component number (p0141)
  - Encoder component number (p0142)
  - Encoder type selection (p0400)

The parameters that are grouped together in the encoder data set are identified in the SINAMICS parameter list by "Data Set EDS" and are assigned an index [0..n].

A separate encoder data set is required for each encoder controlled by the control unit. Up to 3 encoder data sets are assigned to a drive data set via parameters p0177, p0178 and p0179.

One drive object can manage up to 3 encoder data sets. The number of encoder data sets configured is specified in p0140.

When a drive data set is selected, the assigned encoder data sets are selected automatically.

NOTE

All of the drive data sets of a drive object can only be assigned to the same encoder data sets. It is not possible to toggle between various encoder data sets.

MDS: Motor Data Set

A motor data set contains various adjustable parameters describing the connected motor for the purpose of configuring the drive. It also contains certain visualization parameters with calculated data.

- Adjustable parameters, e.g.:
  - Motor component number (p0131)
  - Motor type selection (p0300)
  - Rated motor data (p0304 ff)
  - ...
- Visualization parameters, e.g.:
  - Calculated rated data (p0330 ff)
  - ...

The parameters that are grouped together in the motor data set are identified in the SINAMICS parameter list by "Data Set MDS" and are assigned an index [0..n].

A separate motor data set is required for each motor that is controlled by the control unit via a power module. The motor data set is assigned to a drive data set via parameter p0186.

A motor data set can only be changed using a DDS changeover.

The motor data set changeover is, for example, used for:

- Changing over between different motors
- Changing-over between different windings in a motor (e.g. star-delta changeover)
- Motor data adaptation

If several motors are operated alternately on one Power Module, a matching number of drive data sets must be created. Refer to Chapter 9.2 "Drive functions" for additional information and instructions on changing over motors.

NOTICE

Only a motor connected to a Power Module can have an encoder – all additional motors must be operated without encoder (sensorless operation).

A drive object can manage a max. of 16 motor data sets. The number of motor data sets in p0130 may not exceed the number of drive data sets in p0180.

Copying the Command Data Set (CDS)

Set parameter p0809 as follows:

1. p0809[0] = number of the command data set to be copied (source)
2. p0809[1] = number of the command data to which the data is to be copied (target)
3. p0809[2] = 1

Start copying.

Copying is finished when p0809[2] = 0.

Copying the Drive Data Set (DDS)

Set parameter p0819 as follows:

1. p0819[0] = Number of the drive data set to be copied (source)
2. p0819[1] = Number of the drive data set to which the data is to be copied (target)
3. p0819[2] = 1

Start copying.

Copying is finished when p0819[2] = 0.

Copying a motor data set (MDS)

Set parameter p0139 as follows:

1. p0139[0] = Number of the motor data set to be copied (source)
2. p0139[1] = Number of the motor data set which should be copied into (target)
3. p0139[2] = 1

Start copying.

Copying is finished when p0139[2] = 0.

Function Diagrams

- 8560 Command data set (CDS)
- 8565 Drive data set (DDS)
- 8570 Encoder data set (EDS)
- 8575 Motor data set (MDS)

Parameters

- p0120 Power module data sets (PDS) number
- p0130 Motor data sets (MDS) number
- p0139[0...2] Copy motor data set MDS
- p0140 Encoder data sets (EDS) number
- p0170 Command data set (CDS) number
- p0180 Drive data set (DDS) number
- p0809[0...2] Copy command data set CDS
- p0810 BI: Command data set selection CDS bit 0
- p0811 BI: Command data set selection CDS bit 1
- p0812 BI: Command data set selection CDS bit 2
- p0813 BI: Command data set selection CDS bit 3
- p0819[0...2] Copy drive data set DDS
- p0820 BI: Drive data set selection, bit 0
- p0821 BI: Drive data set selection, bit 1
- p0822 BI: Drive data set selection, bit 2
- p0823 BI: Drive data set selection, bit 3
- p0824 BI: Drive data set selection, bit 4

6.3.4 BICO Technology: Interconnection of Signals

Description

Every drive contains a large number of interconnectable input and output variables and internal control variables.

BICO technology (Binector Connector Technology) allows the drive to be adapted to a wide variety of conditions.

Digital and analog signals, which can be connected freely by means of BICO parameters, are identified by the prefix BI, BO, CI or CO in their parameter name. These parameters are identified accordingly in the parameter list or in the function diagrams.

NOTE

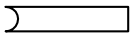
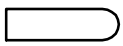
The STARTER parameterization and commissioning tool is recommended when using BICO technology.

Binectors, BI: Binector Input, BO: Binector Output

A binector is a digital (binary) signal without a unit which can assume the value 0 or 1.

Binectors are subdivided into binector inputs (signal sink) and binector outputs (signal source).

Table 6-2 Binectors

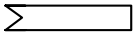
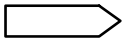
Abbreviation and symbol	Name	Description
BI 	Binector Input Binector Input (signal sink)	Can be interconnected to a binector output as source. The number of the binector output must be entered as a parameter value.
BO 	Binector output Binector Output (signal source)	Can be used as a source for a binector input.

Connectors, CI: Connector Input, CO: Connector Output

A connector is an analog signal. Connectors are subdivided into connector inputs (signal sink) and connector outputs (signal source).

The options for interconnecting connectors are restricted to ensure that performance is not adversely affected.

Table 6-3 Connectors

Abbreviation and symbol	Name	Description
CI 	Connector Input Connector Input (signal sink)	Can be interconnected to a connector output as source. The number of the connector output must be entered as a parameter value.
CO 	Connector Output Connector Output (signal source)	Can be used as a source for a connector input.

Interconnecting Signals Using BICO Technology

To interconnect two signals, a BICO input parameter (signal sink) must be assigned to the desired BICO output parameter (signal source).

The following information is required in order to connect a binector/connector input to a binector/connector output:

- Binectors: Parameter number, bit number, and drive object ID
- Connectors with no index: Parameter number and drive object ID
- Connectors with index: Parameter number, index, and drive object ID

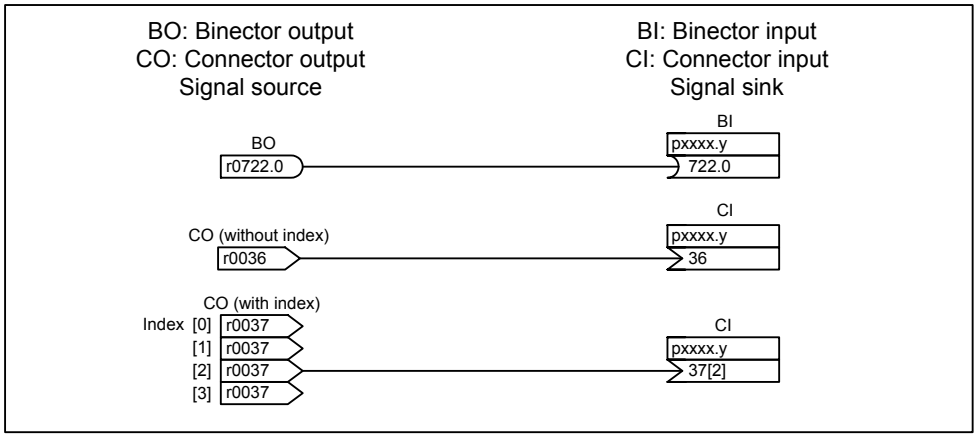


Fig. 6-5 Interconnecting signals using BICO technology

NOTE

A signal source (BO) can be connected to any number of signal sinks (BI).

A signal sink (BI) can only ever be connected to one signal source (BO).

The BICO parameter interconnection can be implemented in different command data sets (CDS). The different interconnections are activated by switching data sets. Interconnections across drive objects are also possible.

Internal Encoding of the Binector/Connector Output Parameters

The internal codes are needed, for example, in order to write BICO input parameters via PROFIBUS.

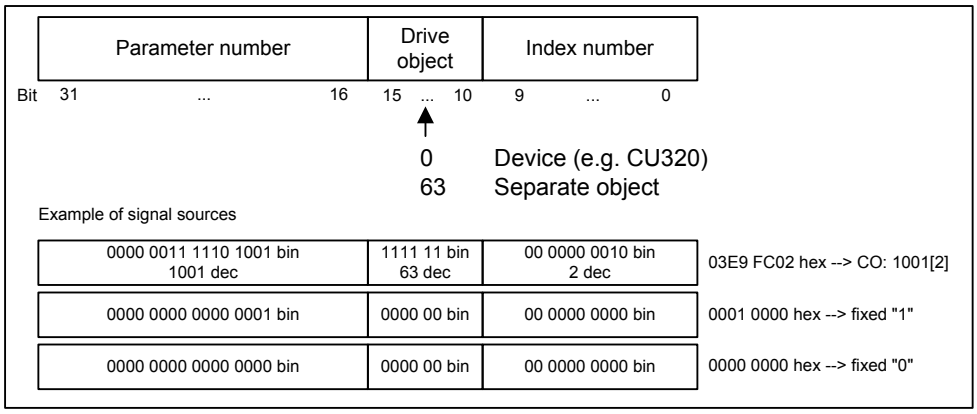


Fig. 6-6 Internal encoding of the binector/connector output parameters

Example 1: Interconnection of digital signals

Suppose you want to operate a drive via terminals DI 0 and DI 1 on the control unit using jog 1 and jog 2.

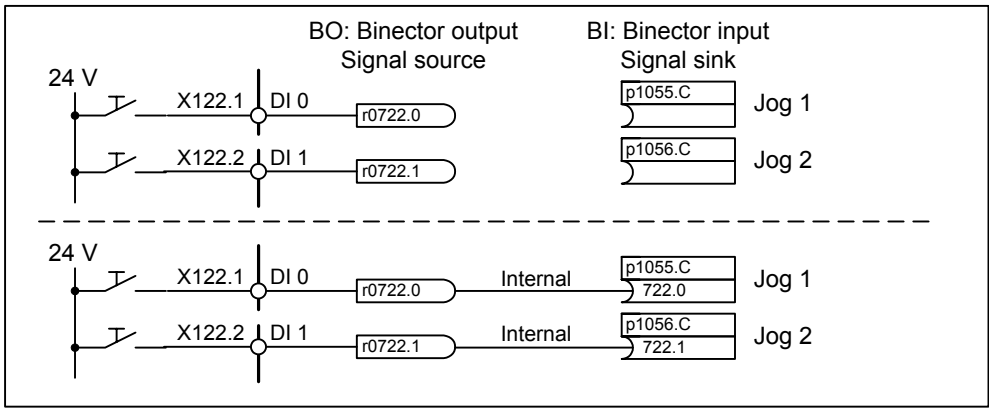


Fig. 6-7 Interconnecting digital signals (example)

Example 2: Connection of OC/OFF3 to several drives

The OFF3 signal is to be connected to two drives via terminal DI 2 on the control unit.

Each drive has a binector input 1. OFF3 and 2. OFF3. The two signals are processed via an AND gate to STW1.2 (OFF3).

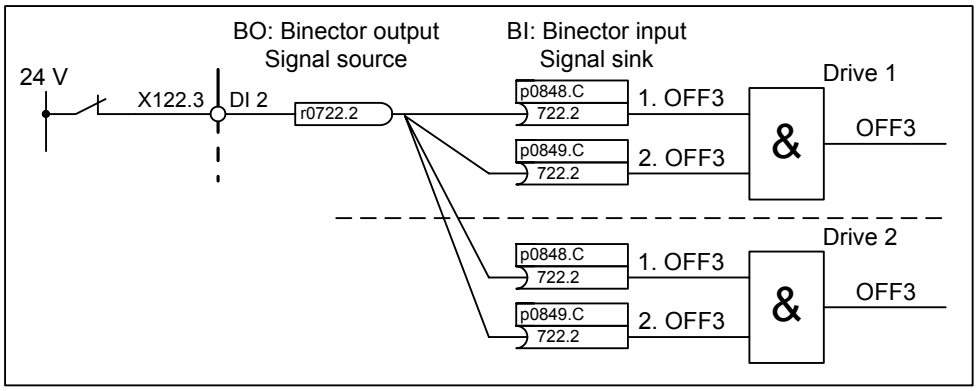


Fig. 6-8 Interconnecting OFF3 with more than one drive (example)

BICO interconnections to other drives

The following parameters are available for BICO interconnections to other drives:

- r9490 number BICO interconnections to other drives
- r9491[0...15] BI/CI of BICO interconnections to other drives
- r9492[0...15] BO/CO of BICO interconnections to other drives
- p9493[0...15] Reset BICO interconnections to other drives

Binector-connector converters and connector-binector converters

Binector-connector converter

- Several digital signals are converted to a 32-bit integer double word or to a 16-bit integer word.
- p2080[0...15] BI: PROFIBUS PZD send bit-serial

Connector-binector converter

- A 32-bit integer double word or a 16-bit integer word is converted to individual digital signals.
- p2099[0...1] CI: PROFIBUS PZD selection receive bit-serial

Fixed Values for Interconnection Using BICO Technology

The following connector outputs are available for interconnecting any fixed value settings:

- p2900[0...n] CO: Fixed value_%_1
- p2901[0...n] CO: Fixed value_%_2
- p2930[0...n] CO: Fixed Value_M_1

Example:

These parameters can be used to interconnect the scaling factor for the main setpoint or to interconnect an additional torque.

6.4 Command Sources

6.4.1 PROFIBUS" Default Setting

Requirements

The "PROFIBUS" default setting was chosen during commissioning:

- STARTER: "Profibus"
- AOP30: "G/S150 Profibus"

Command Sources

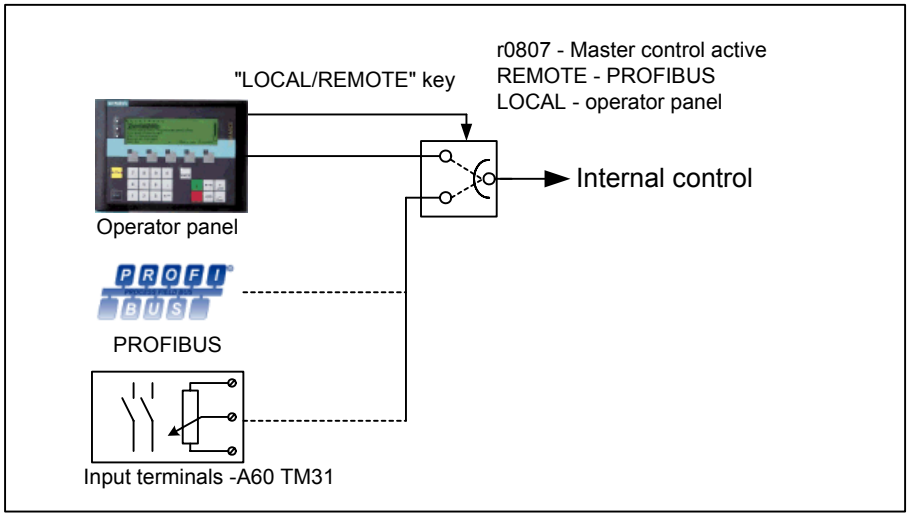


Fig. 6-9 Command sources – AOP30 ←→ PROFIBUS

Priority

The priority of the command sources is shown in Fig. 6-9.

NOTE

The emergency OFF and motor protection signals are always active (regardless of the command source).

For LOCAL master control, all of the supplementary setpoints are de-activated.

TM31 Terminal Assignment with "PROFIBUS" Default Setting

When you choose the PROFIBUS default setting, use the following terminal assignment for TM31:

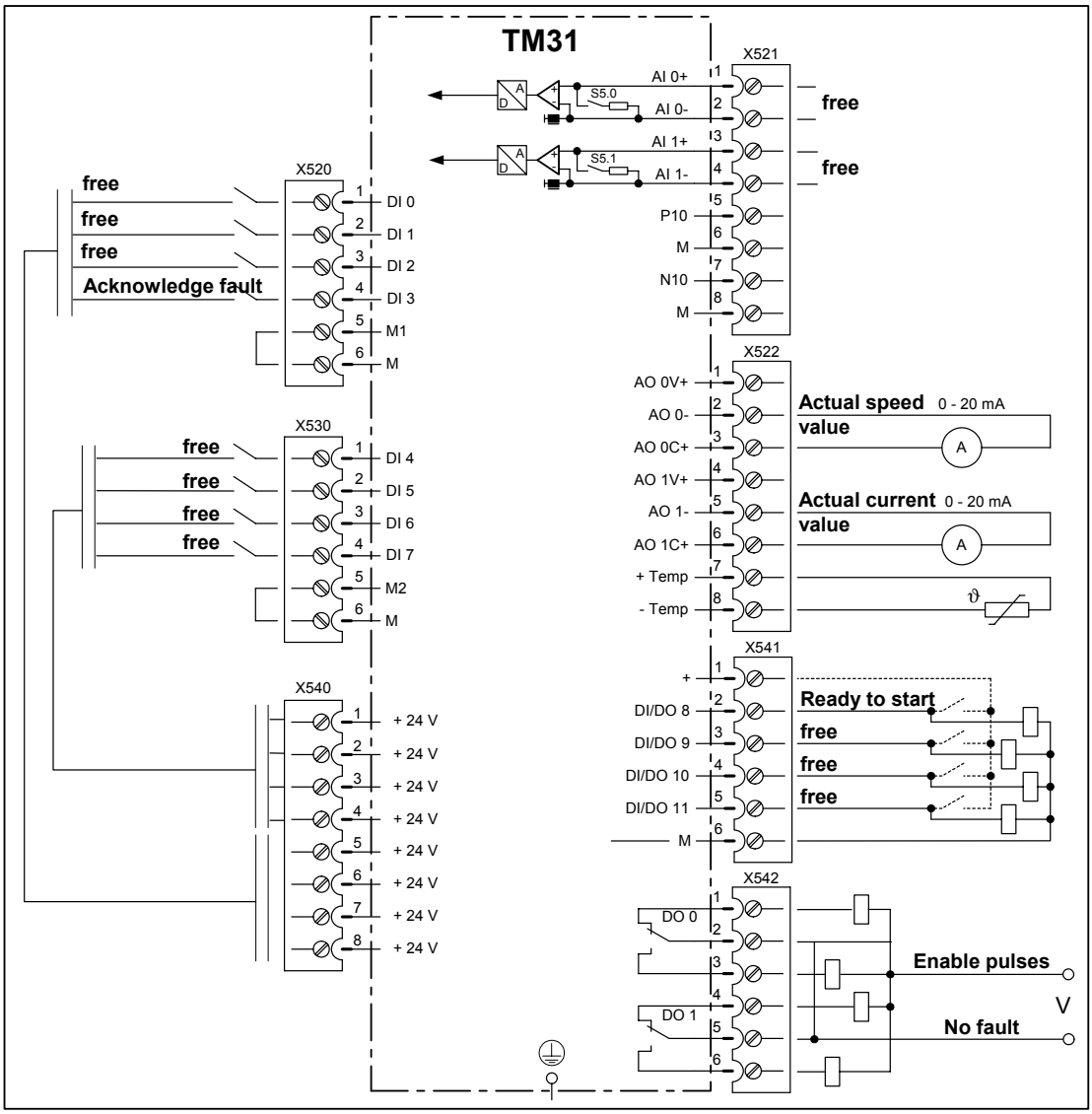


Fig. 6-10 TM31 terminal assignment with "PROFIBUS" default setting

Control word 1

The bit assignment for control word 1 is described in 6.6.4.

Status word 1

The bit assignment for status word 1 is described in 6.6.5.

Switching the Command Source

The command source can be switched using the LOCAL/REMOTE key on the AOP30.

6.4.2 "TM31 Terminals" Default Setting

Requirements

The "TM31 Terminals" default setting was chosen during commissioning:

- STARTER: "TM31 Terminals"
- AOP30: "G/S150 TM31"

Command Sources

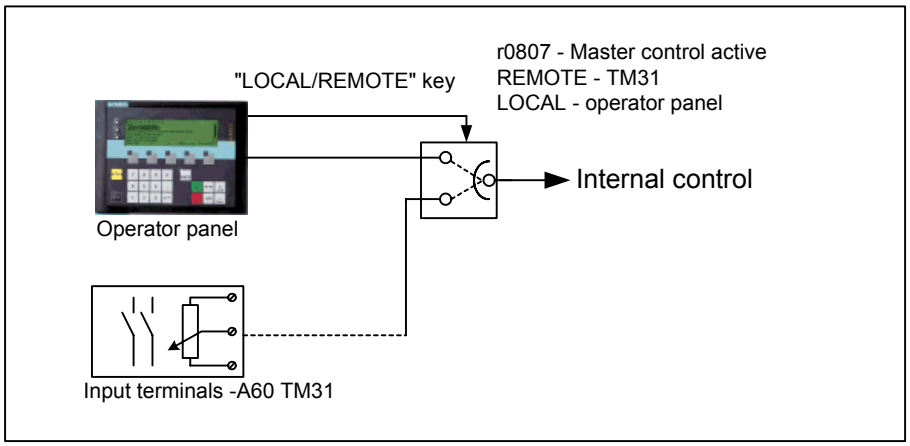


Fig. 6-11 AOP30 command sources ←→ TM31 terminals

Priority

The priority of the command sources is shown in Fig. 6-11.

NOTE

The emergency OFF and motor protection signals are always active (regardless of the command source).

For LOCAL master control, all of the supplementary setpoints are de-activated.

TM31 Terminal Assignment with "TM31 Terminals" Default Setting

When you choose the "TM31 Terminals" default setting, the terminal assignment for TM31 is as follows:

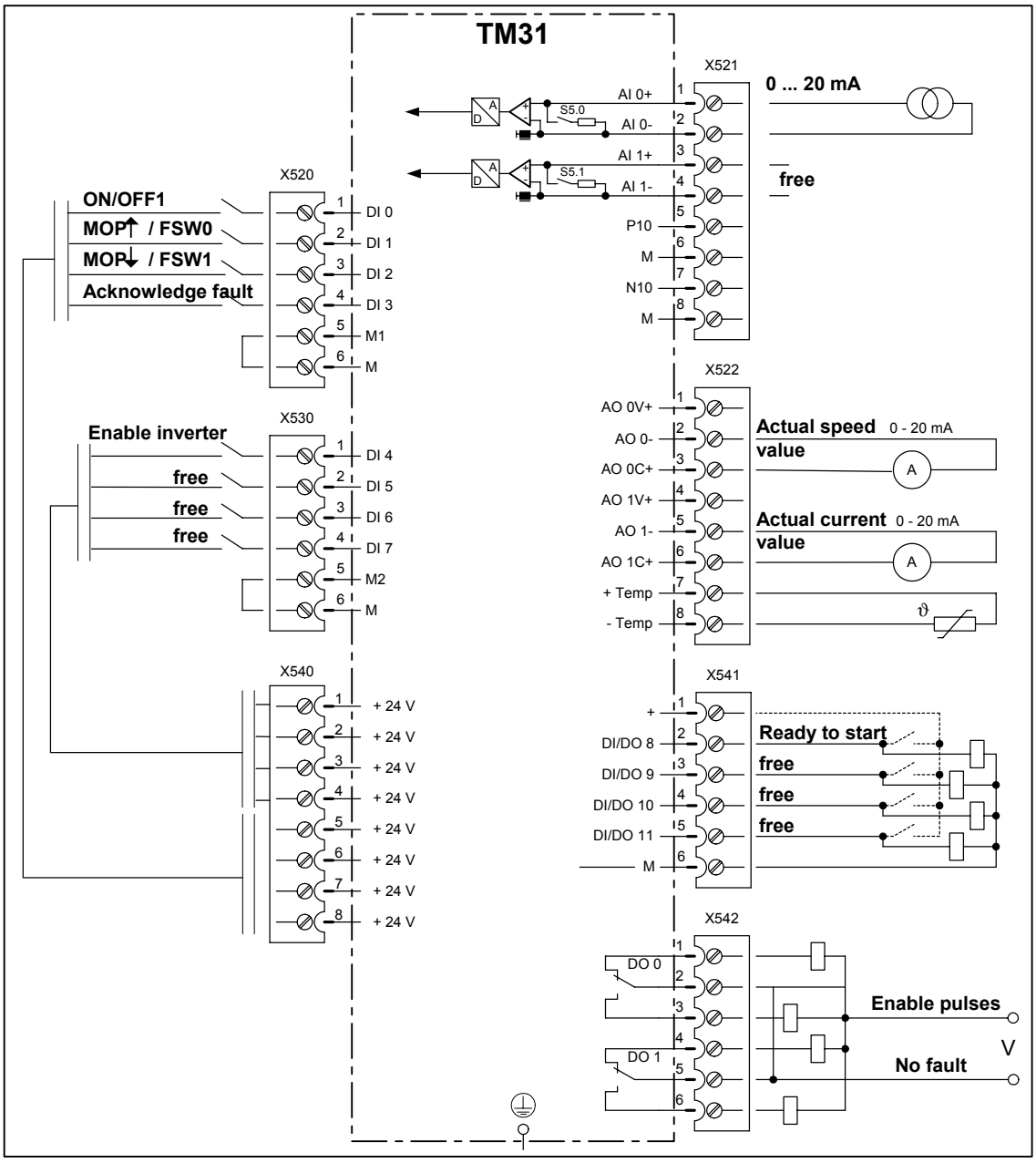


Fig. 6-12 TM31 terminal assignment with "TM31 Terminals" default setting

Switching the Command Source

The command source can be switched using the LOCAL/REMOTE key on the AOP30.

6.4.3 "NAMUR" Default Setting

Requirements

The NAMUR terminal block (option B00) is installed in the cabinet unit.

The "NAMUR" default setting was chosen during commissioning:

- STARTER: "NAMUR"
- AOP30: "G/S150 NAMUR"

Command Sources

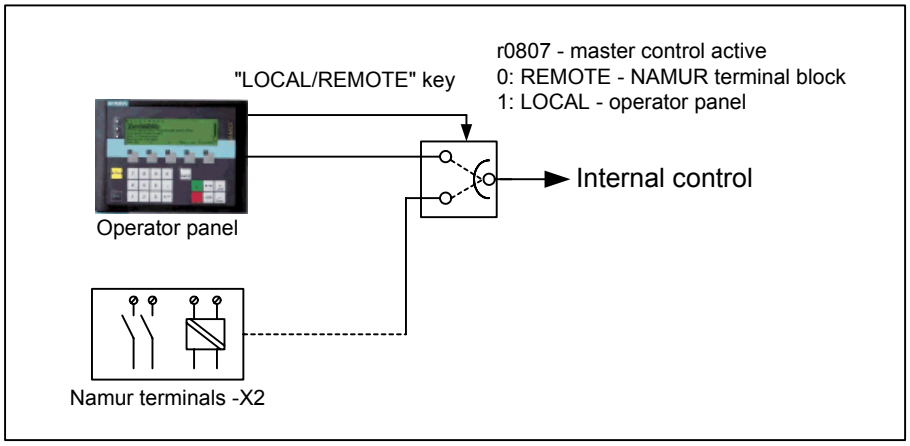


Fig. 6-13 Command sources – AOP30 ←→ NAMUR terminal block

Priority

The priority of the command sources is shown in Fig. 6-13.

NOTE

The emergency OFF and motor protection signals are always active (regardless of the command source).

For LOCAL master control, all of the supplementary setpoints are de-activated.

Terminal Assignment with the "NAMUR" Default Setting

When you choose the "NAMUR" default setting, the terminal assignment is as follows (as with option B00):

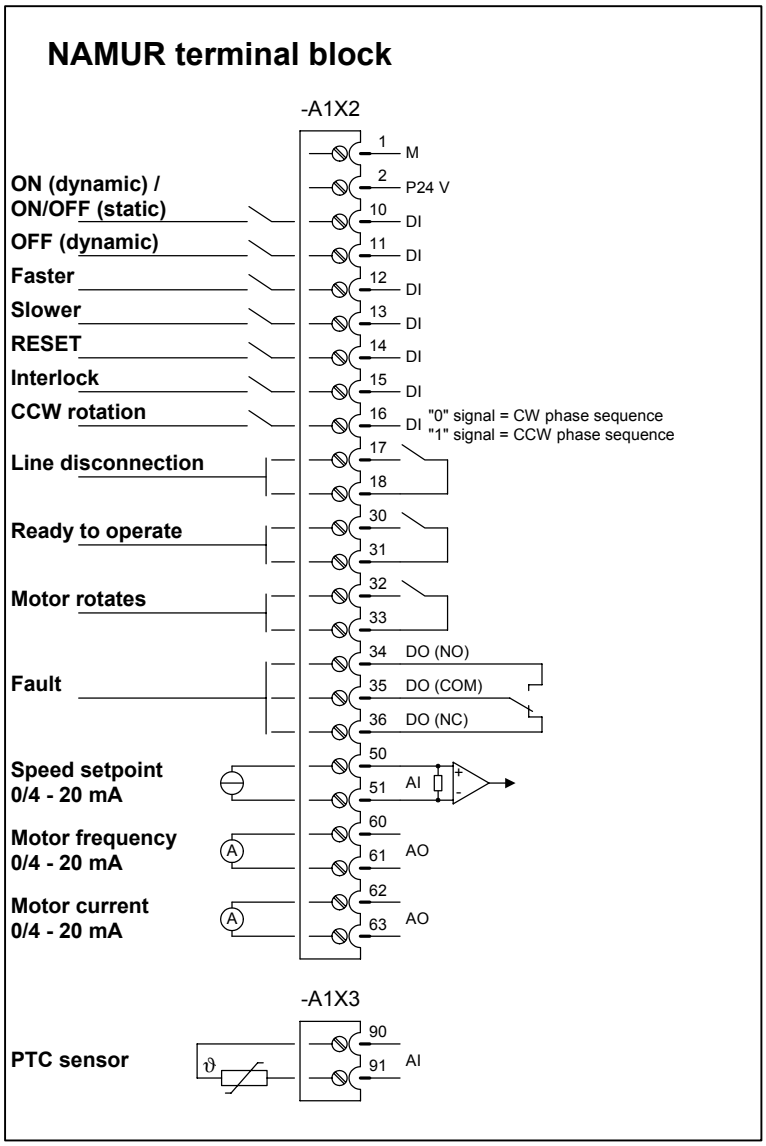


Fig. 6-14 terminal assignment with "NAMUR terminal block" default setting

Switching the Command Source

The command source can be switched using the LOCAL/REMOTE key on the AOP30.

6.4.4 "PROFIdrive NAMUR" Default Setting

Requirements

The PROFIdrive NAMUR (B04) option has been installed in the cabinet unit.

The default setting "NAMUR" was selected when commissioning the drive unit:

- STARTER: "PROFIdrive NAMUR"
- AOP30: "G/S150 PROFIdrive NAMUR"

Command Sources

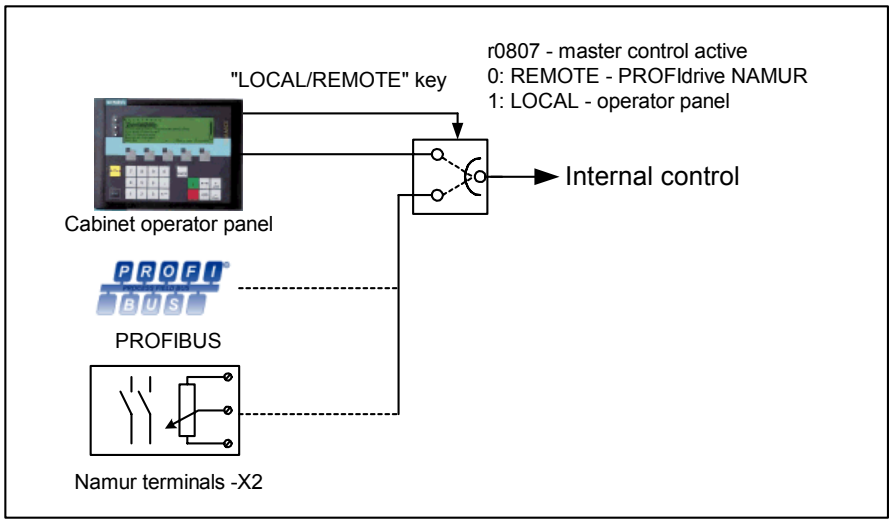


Fig. 6-15 Command sources – AOP30 ←→ PROFIdrive NAMUR

Priority

The priority of the command sources is shown in Fig. 6-15.

NOTE

The emergency OFF and motor protection signals are always active (regardless of the command source).

For LOCAL master control, all of the supplementary setpoints are de-activated.

Terminal assignment for the "PROFIdrive NAMUR" default setting

The following terminal assignment (as for option B04) is obtained when selecting the default setting "PROFIdrive NAMUR":

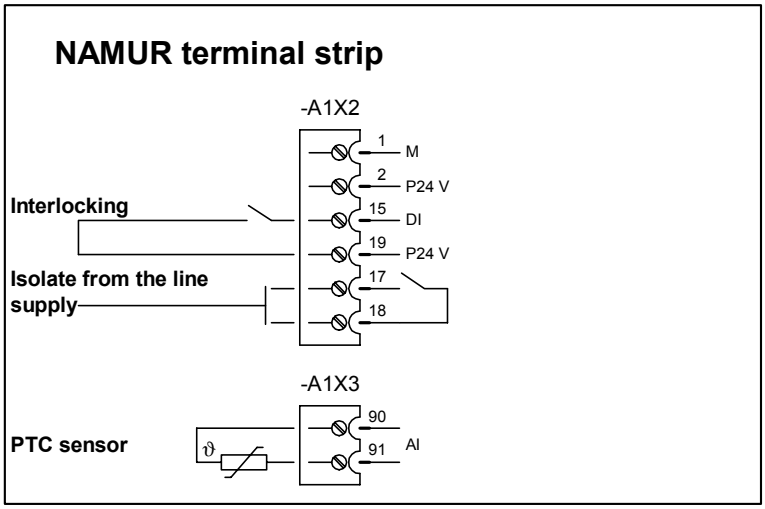


Fig. 6-16 Terminal assignment for the default setting "PROFIdrive NAMUR"

Control word 1

The bit assignment for control word 1 is described in 6.6.4.

Status word 1

The bit assignment for status word 1 is described in 6.6.5.

Switching the Command Source

The command source can be switched using the LOCAL/REMOTE key on the AOP30.

6.5 Setpoint Sources

6.5.1 Analog Inputs

Description

The customer terminal block TM31 features two analog inputs for specifying setpoints for current or voltage signals.

In the factory setting, analog input 0 (terminal X521:1/2) is used as a current input in the range 0 to 20 mA.

Requirements

The default setting for analog inputs was chosen during commissioning:

- STARTER: "TM31 Terminals"
- AOP30: "TM31_AI0"

Signal Flow Diagram

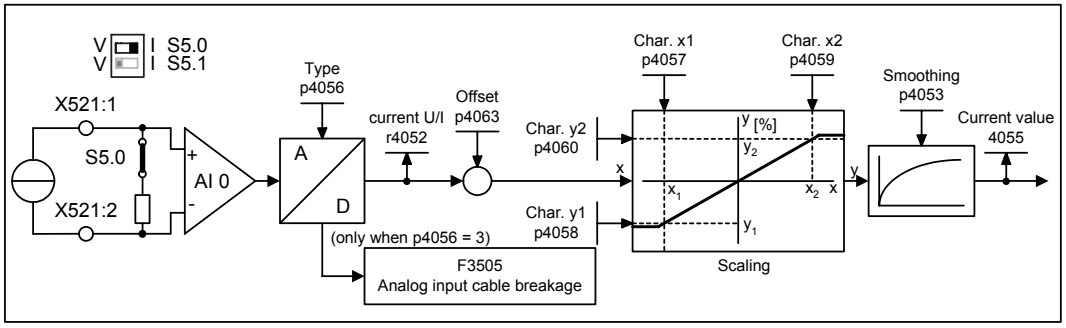


Fig. 6-17 Signal flow diagram: analog input 0

Function diagram

FD 9566, 9568

Parameters

- r4052 Actual input voltage/current
- p4053 Analog inputs smoothing time constant
- r4055 Analog inputs, actual input value in percent
- p4056 Analog inputs type
- p4057 Analog inputs, characteristic value x1
- p4058 Analog inputs, characteristic value y1

- p4059 Analog inputs, characteristic value x2
- p4060 Analog inputs, characteristic value y2
- p4063 Analog inputs offset

NOTE

In the factory setting and after basic commissioning, an input current of 20 mA is equal to the main setpoint 100 % reference speed (p2000), which has been set to the maximum speed (p1082).

Example: Changing Analog Input 0 from Current to Voltage Input –10 to +10 V

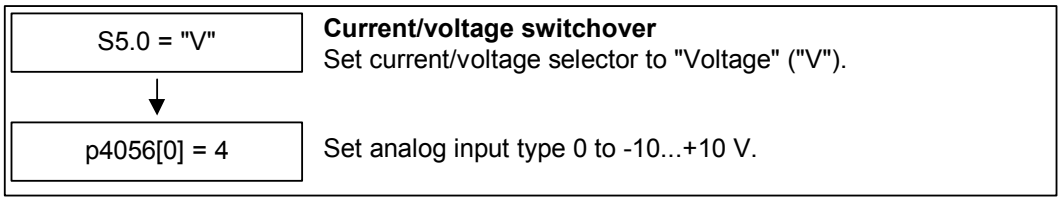


Fig. 6-18 Example: Setting analog input 0

NOTE

The new analog input must then be stored on the CompactFlash card so that it is protected in the event of a power failure.

F3505 – Fault: "Analog Input Cable Breakage"

The fault is triggered when analog input type (p4056) is set to 3 (4 ... 20 mA with open-circuit monitoring) and the input current of 2 mA has been undershot.

The fault value can be used to determine the analog input in question.

Example

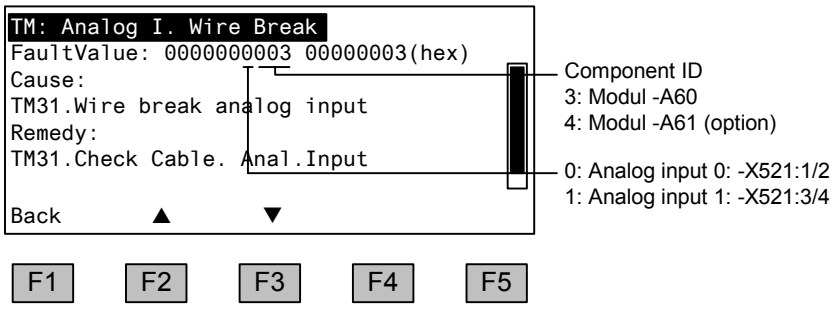


Fig. 6-19 Fault screen

6.5.2 Motorized Potentiometer

Description

The digital motorized potentiometer enables you to set speeds remotely using switching signals (+/- keys). It is activated via terminals or PROFIBUS. As long as a logical 1 is present at signal input "MOP raise" (setpoint higher), the internal numerator integrates the setpoint. You can set the integration time (time taken for the setpoint to increase) using parameter p1047. In the same way, you can decrease the setpoint using signal input "MOP lower". The deceleration ramp can be set using parameter p1048.
Configuration parameter p1030.0 = 1 (default setting = 0) is used to activate that the actual motorized potentiometer is saved in a non-volatile fashion when powering-down the drive unit. When powering-up the drive unit, the starting (initial) value of the motorized potentiometer is set to the last, actual value that was present when the drive unit was powered-down.

Requirements

The default setting for the motorized potentiometer was chosen during commissioning:

- STARTER: "Motorized potentiometer"
- AOP30: "Motorized potentiometer"

Signal Flow Diagram

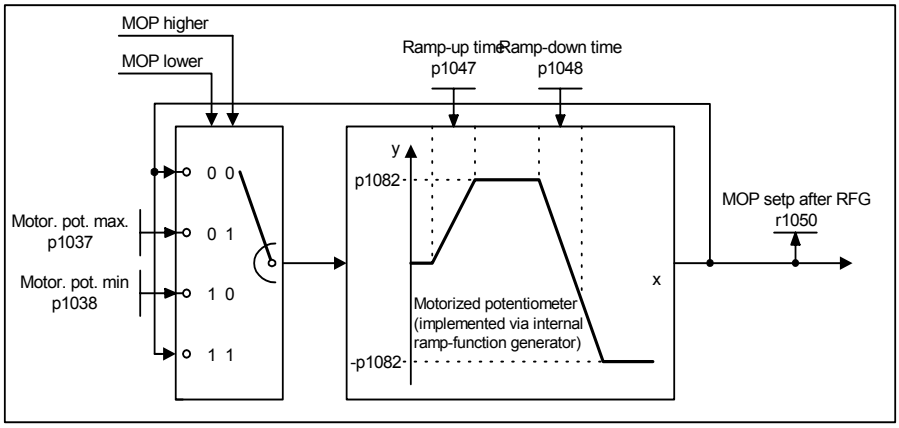


Fig. 6-20 Signal flow diagram: Motorized potentiometer

Function diagram

FD 3020

Parameters

- p1030 Motorized potentiometer, configuration
- p1037 Motorized potentiometer, maximum speed
- p1038 Motorized potentiometer, minimum speed
- p1047 Motorized potentiometer, ramp-up time
- p1048 Motorized potentiometer, ramp-down time
- r1050 Motorized potentiometer, setpoint after the ramp-function generator

6.5.3 Fixed Speed Setpoints

Description

Three settable fixed speed setpoints are available. They can be selected via terminals or PROFIBUS.

Requirements

The default setting for the fixed speed setpoints was chosen during commissioning:

- STARTER: "Fixed setpoint"
- AOP30: "Fixed setpoint"

Signal Flow Diagram

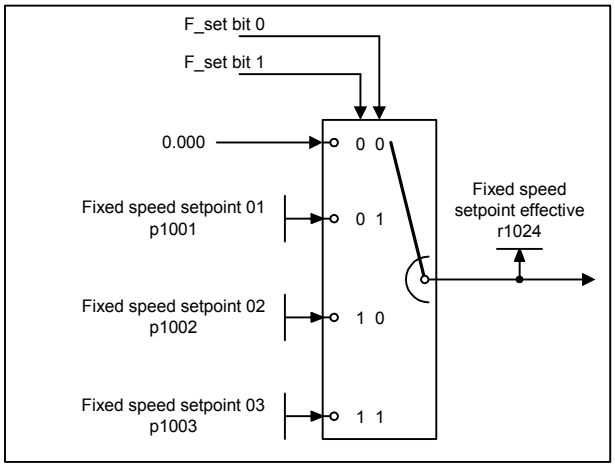


Fig. 6-21 Signal flow plan: Fixed speed setpoints

Function diagram

FD 3010

Parameters

- p1001 Fixed speed setpoint 1
- p1002 Fixed speed setpoint 2
- p1003 Fixed speed setpoint 3
- r1024 Fixed speed setpoint effective

6.6 PROFIBUS

6.6.1 PROFIBUS Connection

PROFIBUS Connection Position, Address Switch, and Diagnostic LED

The PROFIBUS connection, address switch, and diagnostics LED are located on the control unit.

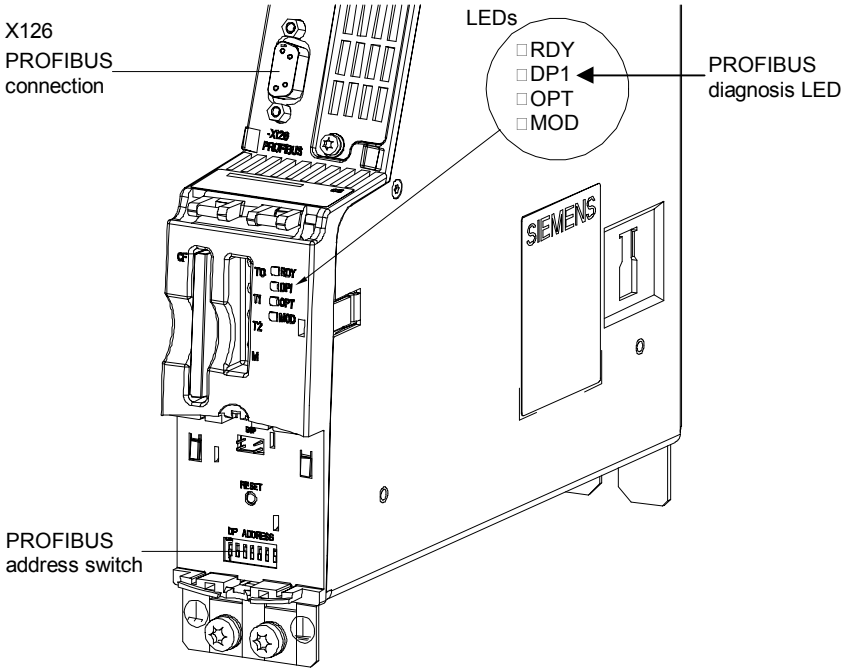
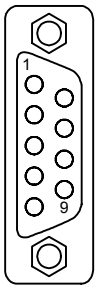


Fig. 6-22 View of the control unit with PROFIBUS interface

PROFIBUS Connection

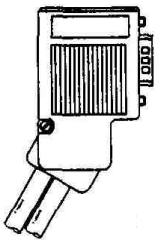
The PROFIBUS is connected by means of a 9-pin Sub-D socket (X126). The connections are electrically isolated.

Table 6-4 X126 - PROFIBUS connection

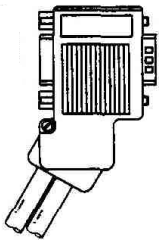
	Pin	Signal name	Meaning	Range
	1	SHIELD	Ground connection	
	2	M24_SERV	Power supply for teleservice, ground	0 V
	3	RxD/TxD-P	Receive / transmit data P (B/B')	RS485
	4	CNTR-P	Control signal	TTL
	5	DGND	PROFIBUS data reference potential (C/C')	
	6	VP	Supply voltage plus	5 V ± 10 %
	7	P24_SERV	Power supply for teleservice P, + (24 V)	24 V (20.4 V - 28.8 V)
	8	RxD/TxD-N	Receive / transmit data N (A/A')	RS485
	9	-	Not used	

Connectors

The cables must be connected via PROFIBUS connectors because they contain terminating resistors.



PROFIBUS plug without PG/PC connection 6ES7972-0BA41-0XA0



PROFIBUS plug with PG/PC connection 6ES7972-0BB41-0XA0

Fig. 6-23 PROFIBUS connectors

Bus Terminating Resistor

The bus terminating resistor must be switched on or off depending on its position in the bus, otherwise the data will not be transmitted properly.

Principle: the terminating resistors must only be switched on at both ends of the bus line; the resistors must be switched off at all other connectors.

The cable shield must be connected at both ends over large-surface area contacts.

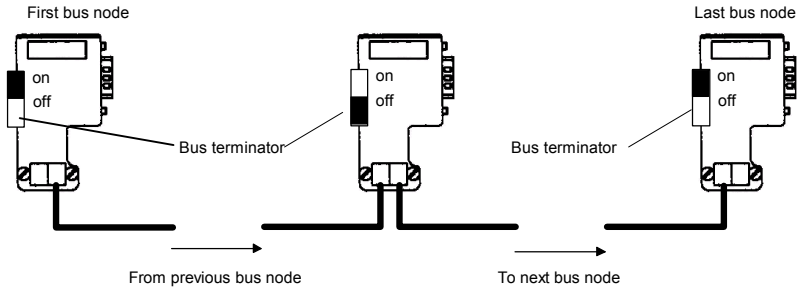


Fig. 6-24 Position of the bus terminating resistors

Cable Routing

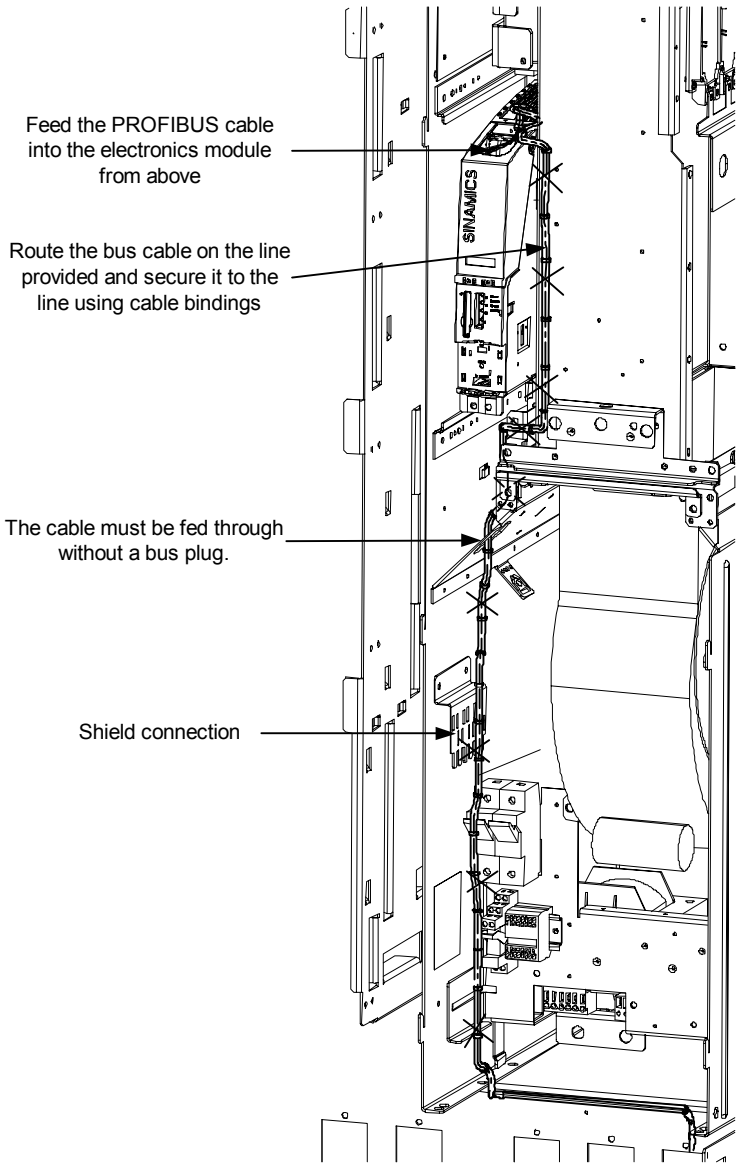

Feed the PROFIBUS cable into the electronics module from above
Route the bus cable on the line provided and secure it to the line using cable bindings
The cable must be fed through without a bus plug.
Shield connection
SINAMICS

Fig. 6-25 Cable routing

6.6.2 Control via PROFIBUS

6.6.2.1 General information

"DP1 (PROFIBUS)" Diagnostics LED

The PROFIBUS diagnostics LED is located on the front of the control unit (see 6.6.1) Its statuses are described in the following table.

Table 6-5 Description of the DP1 LED

Color	Status	Description
------	OFF	Cyclic communication has not (yet) taken place.
Green	Continuous	PROFIBUS is ready for communication and cyclic communication is running
Green	Flashing 0.5 Hz	Full cyclic communication is not yet taking place. Possible causes: • The master is not transmitting setpoints.
Red	Continuous	Cyclic communication has been interrupted.

6.6.2.2 Setting the PROFIBUS Address

Two methods are available for setting the PROFIBUS address:

- The address switches (DIP switches) on the front of the control unit behind the cover plate (see 6.6.1).
  If you use the address switch, parameter p0918 is read only and displays the address that is set.
  If the switch is reset, the new setting does not become effective until the control unit is switched on.
- Entering parameter p0918 on the operator panel.
  You can **only** do this if the address has been set to 0 or 127 using the address switch, that is, all switches from S1 to S7 are set to ON or OFF.
  In this case, changes become effective immediately.

Table 6-6 PROFIBUS address switches

Switch	Significance	Technical specifications
S1	$2^0 = 1$	Significance: 2^0 2^1 2^2 2^3 2^4 2^5 2^6 / 1 2 4 8 16 32 64
S2	$2^1 = 2$	
S3	$2^2 = 4$	
S4	$2^3 = 8$	
S5	$2^4 = 16$	
S6	$2^5 = 32$	
S7	$2^6 = 64$	Example: S1 ... S7; ON / OFF; 1 + 4 + 32 = 37

6.6.2.3 Setting the PROFIBUS Ident Number

The PROFIBUS Ident Number (PNO-ID) can be set using p2042.

SINAMICS can be operated on PROFIBUS with various identities. This allows a PROFIBUS GSD that is independent of the device to be used (e.g. PROFIdrive VIK-NAMUR with Ident Number 3AA0 hex).

- 0: SINAMICS S/G
- 1: VIK-NAMUR

A new setting only becomes effective after POWER ON, reset or download.

NOTE

The advantages of Totally Integrated Automation (TIA) can only be utilized when selecting "0".

6.6.3 Telegrams and Process Data

General information

Selecting a telegram via CU parameter p0922 determines which process data is transferred between the master and slave.

From the perspective of the slave (SINAMICS G150), the received process data comprises the receive words and the process data to be sent the send words.

The receive and send words comprise the following elements:

- Receive words: Control words and setpoints
- Send words: Status words and actual values

"Profibus" Default Settings

When the "Profibus" default setting is chosen for command and setpoint selection (see 6.4.1), "Free telegram" (p0922 = 999) is selected.

The receive telegram is parameterized as follows as a result of the default setting (plan 622):

CTW 1	N_SETP

The send telegram is parameterized as follows (factory setting, plan 623):

STW 1	N_ACT	I_ACT	M_ACT	P_ACT	Fault

You do not have to make any further settings in order to use these telegrams.

User-Defined Telegram Selection

a. Standard telegrams

Standard telegrams are structured in accordance with PROFIdrive profile V3 or internal company specifications. The internal process data links are established automatically in accordance with the telegram number setting in CU parameter p0922.

The following standard telegrams can be set via parameter p0922:

- p0922 = 1 -> Speed control, 2 words
- p0922 = 20 -> NAMUR telegram
- p0922 = 352 -> PCS7 telegram

Depending on the setting in p0922, the interface mode of the control and status word is automatically set:

- p0922 = 1, 352, 999:
  STW 1/ZSW 1: Interface Mode SINAMICS / MICROMASTER, p2038 = 0
- p0922 = 20:
  STW 1/ZSW 1: Interface Mode PROFIdrive VIK-NAMUR, p2038 = 2

b. Free telegrams (p0922 = 999)

Send and receive telegrams can be configured as required by using BICO technology to interconnect the send and receive words. The default process data assigned under a) is retained during the switchover to p0922 = 999, although it can be changed or supplemented at any time.

To maintain compliance with the PROFIdrive profile, however, the following assignments should be retained:

- Interconnect PZD receive word 1 as control word 1 (CTW 1)
- Interconnect PZD send word 1 as status word 1 (STW 1)

For more information about possible interconnections, see function diagrams FP2460 to FP2460 and the simplified diagrams 620 to 622.

Structure of the Telegrams

Table 6-7 Structure of the telegrams

Telegr.	PZD 1	PZD 2	PZD 3	PZD 4	PZD 5	PZD 6	PZD 7	PZD 8	PZD 9	PZD 10
1	CTW 1	N_setp								
	STW 1	N_act								
20	CTW 1	N_setp								
	STW 1	N_act_GLATT	Ia_act_GLATT	M_act_GLATT	P_act_GLATT	MELD_NAMUR				
352	CTW 1	N_setp	PCS7_3	PCS7_4	PCS7_5	PCS7_6				
	STW 1	N_act_GLATT	Ia_act_GLATT	M_act_GLATT	WARN_CODE	FAULT_CODE				
999	CTW 1	free	free	free	free	free	free	free	free	free
	STW 1	free	free	free	free	free	free	free	free	free

6.6.4 Description of Control Words and Setpoints

Overview

Table 6-8 Overview of control words and setpoints

Abbreviation	Description	Parameter	Function diagram
CTW 1	Control word 1 (Interface Mode SINAMICS / MICROMASTER, p2038 = 0)	See Table 6-9	FP2442
CTW 1	Control word 1 (Interface Mode PROFIdrive VIK-NAMUR, p2038 = 2)	See Table 6-10	FP2441
N_setp	Speed setpoint	p1070	FP3030
PCS7_x	PCS7-specific setpoints		

Control Word 1 (CTW 1) (Interface Mode SINAMICS / MICROMASTER, p2038 = 0)

Table 6-9 Control word 1 (Interface Mode SINAMICS / MICROMASTER, p2038 = 0)

Bit	Meaning	Explanation	Operating condition	BICO
0	**0 = OFF1 (OFF1)**	0 : Deceleration on the deceleration ramp (p1121), then pulse block, main contactor (if fitted) is opened.	1	BI: p0840
	1 = ON			
1	**0 = Coast to stop (OFF2)**	0 : Pulse block, main contactor (if fitted) is opened	1	BI: p0844 BI: p0845
	1 = Do not coast to stop			
	Note: Control signal OFF2 is generated by ANDing BI: p0844 and BI: p0845.			
2	**0 = Fast stop (OFF3)**	0: Deceleration on the rapid-stop ramp (p1115), then pulse block, main contactor (if fitted) is opened.	1	BI: p0848
	1 = No emergency stop			
	Note: Control signal OFF3 is generated by ANDing BI: p0848 and BI: p0849.			
3	0 = Disable operation	1: Enable inverter, pulse enable, ramp-up with active setpoint	1	BI: p0852
	1 = Enable operation	0: Pulse inhibit. The motor coasts down. The "Ready To Run" status remains set.		
4	**0 = Set ramp generator to zero**	0: The ramp generator output is set to setpoint "0".	1	BI: p1140
	1 = Enable ramp-function generator			
5	**0 = Freeze ramp generator**	0: The current setpoint is frozen at the ramp generator output.	1	BI: p1141
	1 = Restart ramp generator			
6	**1 = Enable speed setpoint**	1: The speed setpoint at the input of the ramp-function generator is enabled.	1	BI: p1142

Bit	Meaning	Explanation	Operating condition	BICO
	0 = Inhibit speed setpoint	0: The speed setpoint at the input of the ramp-function generator is set to zero. The drive brakes in accordance with the ramp-down time set in p1121.		
7	**0 -> 1 = Acknowledge error**	A positive signal transition acknowledges all the current faults	–	BI: p2103
	Note: The error is acknowledged at a 0/1 edge via BI: p2103, BI: p2104, or BI: p2105.			
8	Reserved		–	–
9	Reserved		–	–
10	**1 = Control via PLC**	1: PROFIBUS control words and setpoints are analyzed.	1	BI: p0852
		0: PROFIBUS control words and setpoints are not analyzed.		
	Note: This bit should not be set to "1" until the PROFIBUS slave has returned an appropriate status via STW1.9 = "1".			
11	**1 = Direction of rotation changeover**	1: CCW phase sequence	–	BI: p1113
		0: CW phase sequence		
12	Reserved		–	–
13	**1 = Increase motorized potentiometer**		–	BI: p1035
14	**1 = Decrease motorized potentiometer**		–	BI: p1036
	Note: If motorized potentiometer up and down are both 0 or 1 simultaneously, the momentary setpoint is frozen.			
15	Reserved		–	–

Control Word 1 (CTW 1) (Interface Mode PROFIdrive VIK-NAMUR, p2038 = 2)

Table 6-10 Control word 1 (Interface Mode PROFIdrive VIK-NAMUR, p2038 = 2)

Bit	Meaning	Explanation	Operating condition	BICO
0	**0 = OFF1 (OFF1)**	0 : Deceleration on the deceleration ramp (p1121), then pulse block, main contactor (if fitted) is opened.	1	BI: p0840
	1 = ON			
1	**0 = Coast to stop (OFF2)**	0 : Pulse block, main contactor (if fitted) is opened	1	BI: p0844 BI: p0845
	1 = Do not coast to stop			
	Note: Control signal OFF2 is generated by ANDing BI: p0844 and BI: p0845.			
2	**0 = Fast stop (OFF3)**	0: Deceleration on the rapid-stop ramp (p1115), then pulse block, main contactor (if fitted) is opened.	1	BI: p0848
	1 = No emergency stop			

Bit	Meaning	Explanation	Operating condition	BICO
	Note: Control signal OFF3 is generated by ANDing BI: p0848 and BI: p0849.			
3	0 = Disable operation **1 = Enable operation**	1: Enable inverter, pulse enable, ramp-up with active setpoint 0: Pulse inhibit. The motor coasts down. The "Ready To Run" status remains set.	1	BI: p0852
4	**0 = Set ramp generator to zero** 1 = Enable ramp-function generator	0: The ramp generator output is set to setpoint "0".	1	BI: p1140
5	**0 = Freeze ramp generator** 1 = Restart ramp generator	0: The current setpoint is frozen at the ramp generator output.	1	BI: p1141
6	**1 = Enable speed setpoint** 0 = Inhibit speed setpoint	1: The speed setpoint at the input of the ramp-function generator is enabled. 0: The speed setpoint at the input of the ramp-function generator is set to zero. The drive brakes in accordance with the ramp-down time set in p1121.	1	BI: p1142
7	**0 -> 1 = Acknowledge error**	A positive signal transition acknowledges all the current faults	–	BI: p2103
	Note: The error is acknowledged at a 0/1 edge via BI: p2103, BI: p2104, or BI: p2105.			
8	Reserved		–	–
9	Reserved		–	–
10	**1 = Control via PLC**	1: PROFIBUS control words and setpoints are analyzed. 0: PROFIBUS control words and setpoints are not analyzed.	1	BI: p0852
	Note: This bit should not be set to "1" until the PROFIBUS slave has returned an appropriate status via STW1.9 = "1".			
11	**1 = Direction of rotation changeover**	1: CCW phase sequence 0: CW phase sequence	–	BI: p1113
12	Reserved		–	–
13	Reserved		–	–
14	Reserved		–	–
15	**1 = Data set 2** 0 = Data set 1	1: Parameter data set changeover (DDS) data set 2 is active 0: Parameter data set changeover (DDS) data set 1 is active	–	BI: p0820

Speed Setpoint (N_Setp)

- Speed setpoint with 16-bit resolution incl. sign bit.
- Bit 15 determines the setpoint sign:
  - Bit = 0 → positive setpoint
  - Bit = 1 → negative setpoint
- The speed setpoint is normalized via parameter p2000.
  N_setp = 4000 hex or 16384 dec = speed in p2000

PCS7-Specific Setpoints (PCS7 x)

Depending on the configuration, KP adaptation values for the speed controller and acceleration values or other setpoints, for example, are transferred here. Depending on their application, these variables are generally normalized via parameters p2000 to p2004.

6.6.5 Description of Status Words and Actual Values

Overview

Table 6-11 Overview of status words and actual values

Abbreviation	Description	Parameter	Function diagram
STW 1	Status word 1 (Interface Mode SINAMICS / MICROMASTER, p2038 = 0)	See Table 6-12	FP2452
STW 1	Status word 1 (Interface Mode PROFIdrive VIK-NAMUR, p2038 = 2)	See Table 6-13	FP2451
N_act	Actual speed value	r0063[0]	FP6010
Ia_act	Actual current	r0068[0]	FP6714
M_act	Actual torque value	r0080[0]	FP6714
P_act	Actual power value	r0082[0]	FP6714
N_act_GLATT	Actual speed value smoothed	r0063[1]	FP6010
Ia_act_GLATT	Actual current smoothed	r0068[1]	FP6714
M_act_GLATT	Actual torque value smoothed	r0080[1]	FP6714
P_act_GLATT	Actual power value smoothed	r0082[1]	FP6714
MELD_NAMUR	VIK-NAMUR signaling bit bar	r3113, See Table 6-14	--
Alarm	Alarm code	r2132	FP8065
Fault	Error code	r2131	FP8060

Status Word 1 (Interface Mode SINAMICS / MICROMASTER, p2038 = 0)

Table 6-12 Status word 1 (Interface Mode SINAMICS / MICROMASTER, p2038 = 0)

Bit	Meaning	Explanation		BICO
0	Ready to power up	1	Ready to power up Power supply on, electronics initialized, line contactor released if necessary, pulses inhibited.	BO: r0899.0
		0	Not ready to power up	
1	Ready to run	1	Ready to run Voltage at line module (i.e. line contactor closed (if used)), field being built up.	BO: r0899.1
		0	Not ready to power up Cause: No ON command has been issued.	
2	Operation enabled	1	Operation enabled Enable electronics and pulses, then ramp up to active setpoint.	BO: r0899.2
		0	Operation inhibited	
3	Fault present	1	Fault present The drive is faulty and is, therefore, out of service. The drive switches to Power-on inhibit once the fault has been acknowledged and the cause has been remedied. The active faults are stored in the fault buffer.	BO: r2193.3
		0	No fault present No active fault in the fault buffer.	
4	No OFF2 active / coasting active (OFF2)	1	No OFF2 active	BO: r0899.4
		0	Coasting active (OFF2) An OFF2 command is present.	
5	0 = Fast stop active (OFF3)	1	No OFF3 active	BO: r0899.5
		0	Coasting active (OFF3) An OFF3 command is present.	
6	Power-on inhibit	1	Power-on inhibit A restart is only possible through OFF1 followed by ON.	BO: r0899.6
		0	No power-up inhibit Power up is possible.	
7	Alarm present	1	Alarm present The drive is operational again. No acknowledgement necessary. The active alarms are stored in the alarm buffer.	BO: r2139.7
		0	No alarm present No active alarm is present in the alarm buffer.	

Bit	Meaning	Explanation		BICO
8	Speed setpoint/actual value deviation within tolerance bandwidth	1	Setpoint/actual value monitoring within tolerance bandwidth Actual value within a tolerance bandwidth; dynamic overshoot or shortfall permitted for t < t_{max}: n = $n_{setp}\pm$ f = $f_{setp}\pm$, etc. t_{max} can be parameterized	BO: r2197.7
		0	Setpoint/actual value monitoring not within tolerance band	
9	Control requested for PLC A "1" is always present	1	Control from the PLC	BO: r0899.9
		0	Local operation	
10	f or n comparison value reached or exceeded	1	f or n comparison value reached or exceeded	BO: r2199.1
		0	f or n comparison value not reached	
	Note: The message is parameterized as follows: p2141 Threshold value p2142 Hysteresis			
11	I, M, or P limit not reached / I, M, or P limit reached	1	I, M or P limit not reached	BO: r1407.7
		0	I, M or P limit reached	
12	Reserved			
13	Alarm, motor overtemperature	1	Motor overtemperature alarm active	BO: r2135.14
		0	Motor overtemperature alarm not active	
14	Motor rotates forwards (n_act >= 0)	1	Motor rotates forwards	BO: r2197.3
		0	Motor not rotating forwards	
15	0 = Alarm, power module thermal overload	1	No alarm present	BO: r2135.15
		0	Alarm, power module thermal overload The overtemperature alarm for the power module is active.	

Status Word 1 (Interface Mode PROFIdrive VIK-NAMUR, p2038 = 2)

Table 6-13 Status word 1 (Interface Mode PROFIdrive VIK-NAMUR, p2038 = 2)

Bit	Meaning	Explanation		BICO
0	Ready to power up	1	Ready to power up Power supply on, electronics initialized, line contactor released if necessary, pulses inhibited.	BO: r0899.0
		0	Not ready to power up	
1	Ready to run	1	Ready to run Voltage at line module (i.e. line contactor closed (if used)), field being built up.	BO: r0899.1
		0	Not ready to power up Cause: No ON command has been issued.	

Bit	Meaning	Explanation		BICO
2	Operation enabled	1	Operation enabled Enable electronics and pulses, then ramp up to active setpoint.	BO: r0899.2
		0	Operation inhibited	
3	Fault present	1	Fault present The drive is faulty and is, therefore, out of service. The drive switches to Power-on inhibit once the fault has been acknowledged and the cause has been remedied. The active faults are stored in the fault buffer.	BO: r2193.3
		0	No fault present No active fault in the fault buffer.	
4	No OFF2 active / coasting active (OFF2)	1	No OFF2 active	BO: r0899.4
		0	Coasting active (OFF2) An OFF2 command is present.	
5	0 = Fast stop active (OFF3)	1	No OFF3 active	BO: r0899.5
		0	Coasting active (OFF3) An OFF3 command is present.	
6	Power-on inhibit	1	Power-on inhibit A restart is only possible through OFF1 followed by ON.	BO: r0899.6
		0	No power-up inhibit Power up is possible.	
7	Alarm present	1	Alarm present The drive is operational again. No acknowledgement necessary. The active alarms are stored in the alarm buffer.	BO: r2139.7
		0	No alarm present No active alarm is present in the alarm buffer.	
8	Speed setpoint/actual value deviation within tolerance bandwidth	1	Setpoint/actual value monitoring within tolerance bandwidth Actual value within a tolerance bandwidth; dynamic overshoot or shortfall permitted for $t < t_{max}$: $n = n_{setp}\pm$ $f = f_{setp}\pm$, etc. t_{max} can be parameterized	BO: r2197.7
		0	Setpoint/actual value monitoring not within tolerance band	
9	Control requested for PLC A "1" is always present	1	Control from the PLC	BO: r0899.9
		0	Local operation	
10	f or n comparison value reached or exceeded	1	f or n comparison value reached or exceeded	BO: r2199.1
		0	f or n comparison value not reached	

Bit	Meaning	Explanation		BICO
	Note: The message is parameterized as follows: p2141 Threshold value p2142 Hysteresis			
11	I, M, or P limit not reached / I, M, or P limit reached	1	I, M or P limit not reached	BO: r1407.7
		0	I, M or P limit reached	
12	Reserved			
13	Alarm, motor overtemperature	1	Motor overtemperature alarm active	BO: r2135.14
		0	Motor overtemperature alarm not active	
14	Motor rotates forwards (n_act >= 0)	1	Motor rotates forwards	BO: r2197.3
		0	Motor not rotating forwards	
15	Reserved			

NAMUR signaling bit bar

Table 6-14 NAMUR signaling bit bar

Bit	Meaning	0-signal	1-signal
00	Fault, drive converter data electronics / SW error	No	Yes
01	Line supply fault	No	Yes
02	DC link overvoltage	No	Yes
03	Fault, drive converter power electronics	No	Yes
04	Overtemperature, drive converter	No	Yes
05	Ground fault	No	Yes
06	Motor overload	No	Yes
07	Bus error	No	Yes
08	External safety trip	No	Yes
09	Fault, motor encoder	No	Yes
10	Error, internal communications	No	Yes
11	Fault, infeed	No	Yes
15	Other faults/errors	No	Yes

Actual Speed Value (N_Act, N_Act_GLATT)

- Actual speed value with 16-bit resolution incl. sign bit.
- Bit 15 determines the actual value sign:
  - Bit = 0 → positive actual value
  - Bit = 1 → negative actual value
- The actual speed value is normalized via parameter p2000.
  N_act = 4000 hex or 16384 dec = speed in p2000

Actual Current Value (Ia_Act, Ia_Act_GLATT)

- Actual current value with 16-bit resolution
- The actual current value is normalized via parameter p2002.
  Ia_act = 4000 hex or 16384 dec = current in p2002

Actual Torque Value (M_Act, M_Act_GLATT)

- Actual torque value with 16-bit resolution incl. sign bit.
- Bit 15 determines the actual value sign:
  - Bit = 0 → positive actual value
  - Bit = 1 → negative actual value
- The actual torque value is normalized via parameter p2003.
  M_act = 4000 hex or 16384 dec = torque in p2003

Actual Power Value (P_Act, P_Act_GLATT)

- Actual power value with 16-bit resolution incl. sign bit.
- Bit 15 determines the actual value sign:
  - Bit = 0 → positive actual value
  - Bit = 1 → negative actual value
- The actual power value is normalized via parameter p2004.
  P_act = 4000 hex or 16384 dec = power in p2004

Alarm Code (WARN_CODE)

The number of the current alarm and the last alarm to occur are output here. Decimal notation is used (i.e. value 7910 dec = A07910 (motor overtemperature)).

Fault Code (FAULT_CODE)

The number of the oldest fault still active is output here. Decimal notation is used (i.e. value 7860 dec = F07860 (external fault 1)).

6.7 Control via the Operator Panel

6.7.1 Operator Panel (AOP30) Overview

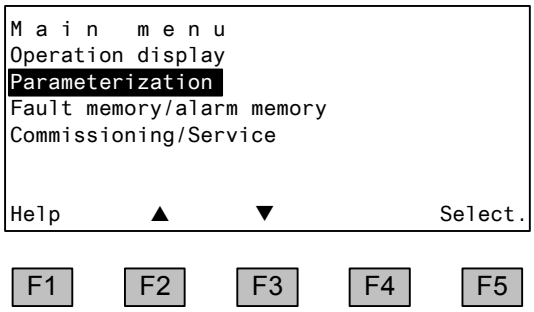
Description

The operator panel can be used for the following activities:

- Parameterization (commissioning)
- Monitoring status variables
- Controlling the drive
- Diagnosing faults and alarms

All the functions can be accessed via a menu.

Your starting point is the main menu, which you can always call up using the yellow MENU key:



The dialog screen for the main menu can be called up at any time using the "MENU" key.

To navigate within the main menu options, choose "F2" or "F3".

Fig. 6-26 Main menu

6.7.2 Menu Structure of the Operator Panel

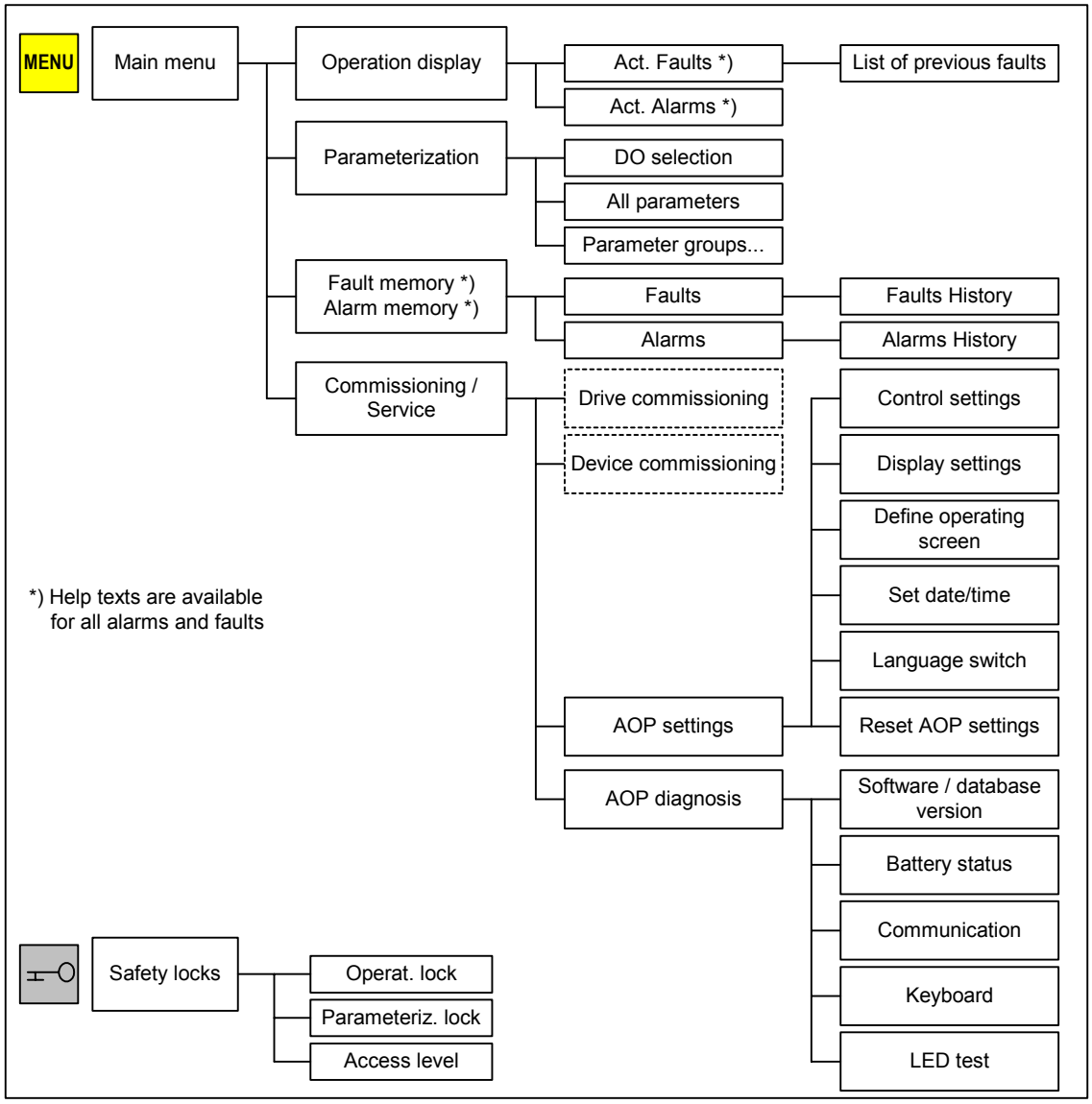


Fig. 6-27 Menu structure of the operator panel

6.7.3 Operation Screen Menu

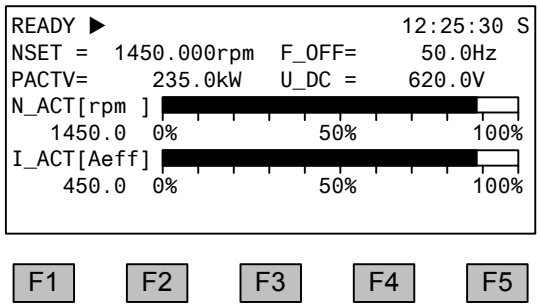
Description

The operation screen displays the most important status variables for the cabinet unit:

In its condition on delivery, it displays the operating status of the drive, the direction of rotation, the time, as well as four drive variables (parameters) numerically and two in the form of a bar display for continuous monitoring.

You can call up the operation screen in one of three ways:

1. After the power supply has been switched on and the system has ramped up.
2. If you do not make any entries for five minutes, the system calls up the operation screen automatically.
3. By pressing the MENU key twice and then F5 OK



If a fault occurs, the system automatically displays the fault screen (see 6.7.8).

In LOCAL control mode, you can choose to enter the setpoint numerically (F2: setpoint).

Settings

When you choose Commissioning / service –> AOP settings –> Define operation screen, you can adjust the display type and the values displayed as required.

See 6.7.6.3

6.7.4 Parameterization Menu

You can adjust the cabinet unit settings in the parameterization menu.

The drive software is modular. The individual modules are called DO ("DriveObject").

The following DOs are available in the G150:

- CU General parameters for the electronics module (CU320)
- Vector Drive control
- TM31 Terminal module TM31

Parameters with identical functions may exist with the same parameter number in more than one DO (e.g. p0002).

The AOP30 is used for operating devices that comprise more than one drive (in this respect, a regulated infeed is also a "drive") so that attention is focused on one drive (i.e. the "current" drive). You can switch between the drives either in the operation screen or in the main menu. The corresponding function key is labeled "Drive".

This drive determines the following:

- Operation screen
- Fault and alarm displays
- Parameterization

Depending on your requirements, you can choose between two AOP display types:

1. All parameters
   All the parameters for the current drive (see above), the CU, and all the other device DOs are displayed in a list (as with older drives). The DO to which the parameter currently selected belongs (inverted) is displayed in curly brackets in the top left of the screen.
   You can also select parameters for just one function group from this complete list.
2. DO selection
   In this display, you can pre-select a DO so that only the parameters for this DO are listed. This display is indicated by the text "DO" next to the DO designator in curly brackets.
   (The expert list in STARTER is only displayed in the DO view.)

In both cases, the set access level and the selected parameter group govern which parameters are displayed. You can set the access level in the menu for inhibit functions, which can be called up using the key button.

The parameters for access levels 1 and 2 are sufficient for simple applications. The default setting is 1 Standard.

At access level 3 (experts), you can change the structure of the function by interconnecting BICO parameters. For this reason, this access level is password protected (password: "47").

The parameter list displays more options than there are function keys. You can use the "<<" key to change the function of the keys. To return from the second menu, press F5 (">>"). Once a function is complete, the system automatically returns to the main menu.

F1 "Help", F2 "DS Select", and F3 "EEPROM" are available in the extended menu.

In the DS Selection menu (data set selection), you can choose which of the data sets chosen is currently DISPLAYED.
Data set parameters are indicated by a “c”, “d”, “m”, or “e” between the parameter number and parameter designator. The second line from the top (aligned right) shows which data sets are currently displayed.

6.7.5 Fault Memory / Alarm Memory

6.7.5.1 Faults

Shows which faults are currently present (max.: 8).

To select one of the faults, choose F2. To call up a description of causes and possible remedies, choose F1 "Help". The fault value, which allows more effective diagnosis, is specified in the second line in Help.

To acknowledge the fault, choose F5 "Ack.". Once you have successfully acknowledged the fault, the system returns to the calling screen. If the fault cannot be acknowledged, the fault screen continues to be displayed.

To display the last eight faults, choose F3 "Old". The system then displays seven acknowledged faults (1st – 7th fault).

6.7.5.2 Alarms

Displays the current content of the alarm buffer. Alarms present at the time the screen was opened are displayed accordingly.

The display can be refreshed with F5: "Refresh". To delete the alarm buffer and rebuild it so that it only contains the currently active alarms, choose F3 "Delete".

6.7.6 Commissioning / Service Menu

6.7.6.1 Drive Commissioning

This option enables you to re-commission the drive from the main menu.

6.7.6.2 Device Commissioning

In this menu, you can enter the device commissioning status directly. This is the only way that you can reset parameters to the factory setting for example.

You can use this menu to create motor data sets in subsequent drive software versions.

6.7.6.3 AOP30 Settings

Control Settings

This defines the settings for the control keys in LOCAL mode.

See 6.7.7.

Display Settings

In this menu, you set the lighting, brightness, and contrast for the display.

Defining the operation screen

In this menu, you can switch between four operation screens. You can set the parameters that are to be displayed.

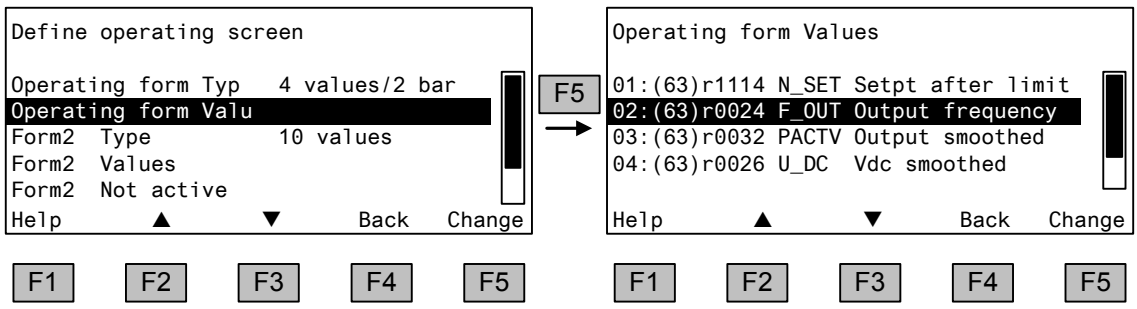


Fig. 6-28 Defining the operation screen

The following image shows how the entries are assigned to the screen positions:

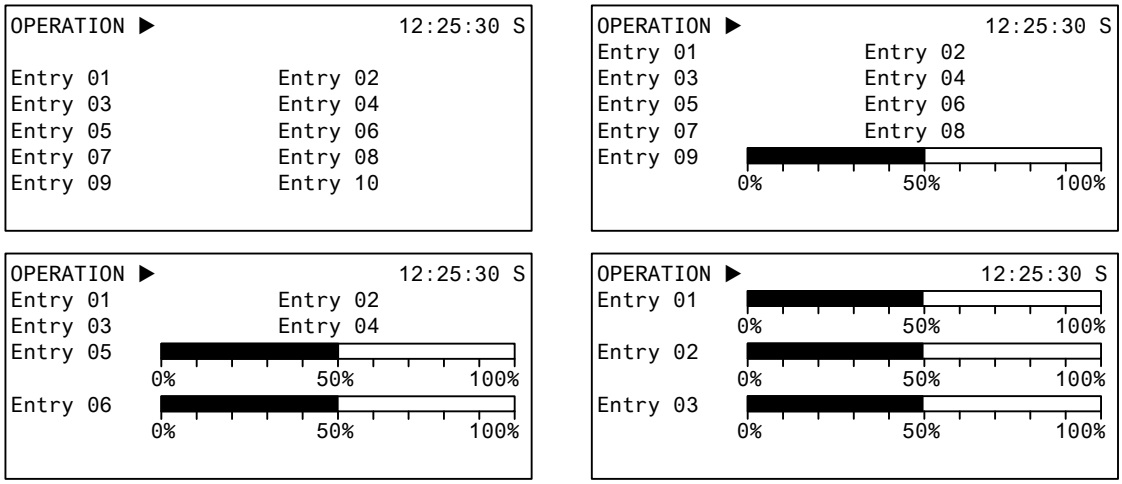


Fig. 6-29 Position of the entries in the operation screen

6.7.6.4 Lists of Signals for the Operation Screen

Vector Object

Table 6-15 List of signals for the operation screen –vector object

Signal	Parameter	Short name	Unit	Scaling (100 % = ...), see Table 6-16
Factory setting (entry no.)				
Speed setpoint upstream of ramp-function generator (1)	r1114	NSET	rpm	p2000
Output frequency (2)	r0024	F_OUT	Hz	Reference frequency
Power smoothed (3)	r0032	PACTV	kW	r2004
DC link voltage, smoothed (4)	r0026	U_DC	V	p2001
Actual speed, smoothed (5)	r0021	N_ACT	rpm	p2000
Absolute actual current, smoothed (6)	r0027	I_ACT	A	p2002
Motor temperature (7)	r0035 [1]	T_MOT	°C	Reference temperature
Converter temperature (8)	r0037	T_PM	°C	Reference temperature
Actual torque smoothed (9)	r0031	M_ACT	Nm	p2003
Converter output voltage smoothed (10)	r0025	U_OUT	V	p2001
For diagnostic purposes				
Speed setpoint smoothed	r0020	NSET	rpm	p2000

[1] If a temperature sensor has not been installed, a value of –200°C is displayed.

Signal	Parameter	Short name	Unit	Scaling (100 % = ...), see Table 6-16
Control factor smoothed	r0028	MODDP	%	Reference control factor
Field-producing current component	r0029	IDACT	A	p2002
Torque-producing current component	r0030	IQACT	A	p2002
Converter overload Degree of thermal overload	r0036	PMI2T	%	100 % = Shutdown
Speed actual value motor sensor	r0061	N_ACT	rpm	p2000
Speed setpoint after filter	r0062	N_ACT	rpm	p2000
Actual speed after smoothing	r0063	N_ACT	rpm	p2000
Speed controller system deviation	r0064		rpm	p2000
Slip frequency	r0065		Hz	Reference frequency
Output frequency	r0066		Hz	Reference frequency
Output voltage	r0072	UACT	V	p2001
Control factor	r0074		%	Reference control factor
Torque-producing actual current	r0078		A	p2002
Actual torque	r0080		Nm	p2003
For further diagnostic purposes				
Fixed speed setpoint effective	r1024		rpm	p2000
Motorized potentiometer after the ramp-function generator	r1050		rpm	p2000
Resulting speed setpoint	r1119		rpm	p2000
Speed controller output	r1508		Nm	p2003
I component of speed controller	r1482		Nm	p2003
PROFIBUS setpoint	r2050		rpm	p2000

Scalings for Vector Object

Table 6-16 Scalings for vector object

Size	Scaling parameter	Default for quick commissioning
Reference speed	100 % = p2000	p2000 = Maximum speed (p1082)
Reference voltage	100 % = p2001	p2001 = 1000 V
Reference current	100 % = p2002	p2002 = Current limit (p0640)
Reference torque	100 % = p2003	p2003 = 2 x rated motor torque
Reference power	100 % = r2004	$r2004 = \frac{p2003 \times p2000 \times \pi}{30}$
Reference frequency	$100\ \% = \frac{p2000}{60}$	
Reference control factor	100 % = Maximum output voltage without overload	
Reference flux	100 % = Rated motor flux	
Reference temperature	100% = 100 °C	

TM31 Object

Table 6-17 List of signals for the operation screen – TM31 object

Signal	Parameter	Unit	Scaling (100 % = ...)
Analog input 0 [V, mA]	r4052[0]	V, mA	V: 100 V / mA: 100 mA
Analog input 1 [V, mA]	r4052[1]	V, mA	V: 100 V / mA: 100 mA
Analog input 0, scaled	r4055[0]	%	V: 100 V / mA: 100 mA
Analog input 1, scaled	r4055[1]	%	V: 100 V / mA: 100 mA

Setting the Date/Time

In this menu, you set the date and time.

Setting the Language

In this menu, you can select the active language.

You have a choice between the two languages currently stored in the operator panel.

If the language you require is not available, you can load it separately (see Chapter 11).

Resetting AOP Settings

This menu option allows you to reset the following settings to the AOP factory settings:

- Language
- Display (brightness, contrast)
- Operation screen
- Control settings

The settings are not effective until the power supply is next switched on.

IMPORTANT

When you reset parameters, all settings that are different to the factory settings are reset immediately. This may cause the cabinet unit to switch to a different, unwanted operational status.

For this reason, you should always take great care when resetting parameters.

6.7.6.5 AOP30 Diagnosis

Software / Database Version

You can use this menu to display the firmware and database versions.

The database version must be compatible with the drive software status (you can check this in parameter r0018).

Battery Status

In this menu, you can display the battery voltage numerically (in Volts) or as a bar display. The battery ensures that the data in the database and the current time are retained.

When the battery voltage is represented as a percentage, a battery voltage of ≤ 2 V is equal to 0%, and a voltage of ≤ 3 V to 100%.

The data is secure up to a battery voltage of 2 V.

- If the battery voltage is ≤ 2.45 V, the message "Replace battery" is displayed in the status bar.
- If the battery voltage is ≤ 2.30V, the system displays a popup window with the following information "Warning: weak battery".
- If the battery voltage is ≤ 2 V, the system displays a popup window with the following information: "Warning: battery is empty".
- If the time and/or database are not available after the system has been switched off for a prolonged period due to the voltage being too low, the loss is established by means of a CRC check when the system is switched on again. This triggers a message instructing the user to replace the battery and then load the database and/or set the time.

For instructions on replacing batteries, see Chapter 11 ("Maintenance and Servicing").

Communication

In this menu, you can call up information on the communications status between the AOP and the drive.

Keyboard

In this screen, you can check that the keys are functioning properly. Keys that you press are represented on a symbolic keyboard on the display. You can press the keys in any order you wish. You cannot exit the screen (F5 – "back") until you have pressed each key at least once.

NOTE

You can also exit the key test screen by pressing any key and keeping it pressed.

LED Test

In this screen, you can check that the 4 LEDs are functioning properly.

6.7.7 Operation via the Operator Panel (LOCAL Mode)

You activate the control keys by switching to LOCAL mode. If the green LED in the LOCAL/REMOTE key does not light up, the key is not active.

For LOCAL master control, all of the supplementary setpoints are de-activated.

After the master control has been transferred to the operator panel, the BICO interconnections at bit 1 to bit 10 of the control word of the sequence control are not effective (refer to function diagram 2501).

6.7.7.1 LOCAL/REMOTE Key

Activate LOCAL mode: press the LOCAL key

LOCAL mode: LED lights up

REMOTE mode: LED does not light up: the ON, OFF, JOG, direction reversal, faster, and slower keys are not active.

Settings: Menu: Commissioning / Service – AOP Settings – Control Settings

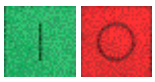
Save LOCAL mode (factory setting: yes)

- **Yes**: "LOCAL" or "REMOTE" operating mode is saved when the supply voltage is switched off, and restored when the supply voltage is switched back on.
- **No**: "LOCAL" or "REMOTE" operating mode is not saved. "REMOTE" is active when the supply voltage is switched back on.

LOCAL/REMOTE also during operation (factory setting: no)

- **Yes**: You can switch between LOCAL and REMOTE when the drive is switched on (motor is running).
- **No**: Before the system switches to LOCAL, a check is carried out to determine whether the drive is in the operational status. If so, the system does not switch to LOCAL and outputs the message "Local not possible". Before the system switches to REMOTE, the drive is switched off and the setpoint is set to 0.

6.7.7.2 ON / OFF Key



ON key: always active in LOCAL when the operator input inhibit is deactivated.

OFF key: in the factory setting, acts as OFF1 = ramp-down at the deceleration ramp (p1121); when n = 0: voltage disconnection (only if a main contactor is installed).
The OFF key is only active in LOCAL mode.

Settings: Menu: Commissioning / Service – AOP Settings – Control Settings

Red OFF key acts as: (factory setting: OFF1)

- **OFF1**: Ramp-down on the deceleration ramp (p1121)
- **OFF2**: Immediate pulse block, motor coasts to a standstill
- **OFF3**: Ramp-down on the emergency stop ramp (p1135)

6.7.7.3 Switching Between Clockwise and Counter-Clockwise Rotation

Settings: Menu: Commissioning / Service – AOP Settings – Control Settings

Switching between CW/CCW (factory setting: no)

- **Yes**: Switching between CW/CCW rotation by means of the CW/CCW key possible in LOCAL mode
- **No**: The CW/CCW key has no effect in LOCAL mode

For safety reasons, the CW/CCW key is disabled in the factory setting (pumps and fans must normally only be operated in one direction).

In the operation status in LOCAL mode, the current direction of rotation is indicated by an arrow next to the operating mode.

NOTE

You have to make additional settings when switching between CW/CCW rotation.

6.7.7.4 Jog

The jog key is effective in the LOCAL mode in the state "ready to power-up" (not in "operation"). The speed that is set in parameter p1051 is approached.

6.7.7.5 Increase Setpoint / Decrease Setpoint

You can use the “increase” and “decrease” keys to set the setpoint with a resolution of 1 % of the maximum speed.
(E.g. if the resolution is 15 min^{-1} at p1082 = 1500 min^{-1}.)

You can also enter the setpoint numerically. To do so, press F2 in the operation screen. The system displays an inverted edit field for entering the required speed. Enter the required value using the numeric keypad. Press F5 OK to confirm the setpoint.

When you enter values numerically, you can enter any speed between the minimum speed (p1080) and the maximum speed (p1082).

Setpoint entry in LOCAL mode is unipolar. You can change the direction of rotation by pressing the key (see 6.7.7.3).

- CW rotation and "Increase key" mean:
  The displayed setpoint is positive and the output frequency is increased.
- CCW rotation and "Increase key" mean:
  The displayed setpoint is negative and the output frequency is increased.

6.7.7.6 AOP Setpoint

Settings: Menu: Commissioning / Service – AOP Settings – Control Settings

Save AOP setpoint (factory setting: no)

- **Yes**: In LOCAL mode, the last setpoint (once you have released the INCREASE or DECREASE key or confirmed a numeric entry) is saved.
  The next time you switch the system on in LOCAL mode, the saved value is selected. This is also the case if you switched to REMOTE in the meantime or the power supply was switched off.
  When the system is switched from REMOTE to LOCAL mode while the drive is switched on (motor is running), the actual value that was last present is set as the output value for the AOP setpoint and saved.
  If the system is switched from REMOTE to LOCAL mode while the drive is switched off, the AOP setpoint that was last saved is used.

- **No**: When you switch the system on in LOCAL mode, setpoint 0 is always selected. When the system is switched from REMOTE to LOCAL mode while the drive is switched on (motor is running), the actual value that was last present is set as the output value for the AOP setpoint.

AOP ramp-up time (factory setting: 20 s)

AOP ramp-down time (factory setting: 30 s)

- **Recommendation**: set as ramp-up/ramp-down time (p1120 / p1121). Changing the ramp-up/ramp-down times does not affect the settings for parameters p1120 and p1121 because this is an AOP-specific setting.

NOTE

The internal drive ramp-function generator is always active.

6.7.7.7 Timeout Monitoring

Settings: Menu: Commissioning / Service – AOP Settings – Control Settings

Timeout monitoring (factory setting: 3000 ms)

The monitoring time continuously monitors communication between the operator panel and drive.

If, when the drive is in LOCAL mode, no communication signal has been received once the monitoring time has elapsed, the drive is stopped with OFF1 and fault F1030 ("control priority monitoring: sign-of-life failure") is displayed.

6.7.7.8 Operator Input Inhibit / Parameterization Inhibit

To prevent users from accidentally actuating the control keys and changing parameters, you can activate an operator input / parameterization inhibit using a key pushbutton. Two key icons appear in the top right of the display when these inhibit functions are enabled.

Table 6-18 Display for operator input / parameterization inhibit

Inhibit type	Online operation	Offline operation
No inhibit		
Operator input inhibit		
Parameterization inhibit		
Operator input inhibit + parameterization inhibit		

Settings

Operator input inhibit (factory setting: no)

- **Yes**: The parameters can still be viewed, but a parameter value cannot be saved (message in the status bar: "Operator input inhibit – parameterization disabled"). The OFF key (red) is enabled. The LOCAL, REMOTE, ON (green), JOG, CW/CCW, INCREASE, and DECREASE keys are disabled.

Parameterization inhibit (factory setting: no)

- **Yes**: Parameters cannot be changed unless a password is entered. The parameterization process is the same as with the operator input inhibit. If you try and change parameters, the message "Parameterization inhibit – no change rights" is displayed in the status bar. All the control keys can, however, still be actuated.

NOTE

If you have forgotten your password, you can switch off the parameterization inhibit as follows:

1. Switch off the power supply
2. Disconnect the RS232 data cable
3. When switching the power supply back on, press the key pushbutton and hold down for 20 s.
4. Press the "Menu" key > "Commissioning/Service" > "AOP settings" > Set "Download AOP settings from the drive" to "No".
5. Press the key-operated button > "Parameteriz. lock" > "Enter new password"
6. Insert the RS232 data cable
7. Press the "Menu" key > Select "run-up".
8. Press the key-operated button
9. Enter the new password
10. Acknowledge "Save data in the drive".
11. When the key symbol in the top right of the display disappears, the access protection function has been reset.

Access level (standard factory setting):

The different parameters required for this complex application are filtered so that they can be displayed as clearly as possible. You select them according to the access level.

An expert level, which must only be used by expert personnel, is required for certain actions. You need a password to activate this level. To activate expert mode, enter code number "47".

The "Expert" access level is not stored permanently, which means that it must be reactivated every time the power is switched on.

6.7.8 Faults and Alarms

Indicating Faults and Alarms

If a fault occurs, the drive displays the fault and/or alarm on the operator panel. Faults are indicated by the red "FAULT" LED and a fault screen is automatically displayed. You can use the F1 Help function to call up information about the cause of the fault and how to remedy it. To acknowledge a stored fault, choose F5 Ack.

Any alarms are displayed by the yellow "ALARM" LED. The system also displays a note in the status bar providing information on the cause.

What is a Fault?

A fault is a message from the drive indicating an error or other exceptional (unwanted) status. This could be caused by a fault within the converter or an external fault triggered, for example, by the winding temperature monitor for the motor. The faults are displayed and can be reported to a higher-level control system via PROFIBUS. In the factory default setting, the message "converter fault" is also sent to a relay output. Once you have rectified the cause of the fault, you have to acknowledge the fault message.

What is an Alarm?

An alarm is the response to a fault condition identified by the drive. It does not result in the drive being switched off and does not have to be acknowledged. Alarms are "self acknowledging", that is, they are reset automatically when the cause of the alarm has been eliminated.

Fault and Alarm Displays

Every fault and alarm is entered in the fault/alarm buffer along with time the error occurred and the time it was rectified. The time stamp relates to the relative system time in milliseconds (r0969).

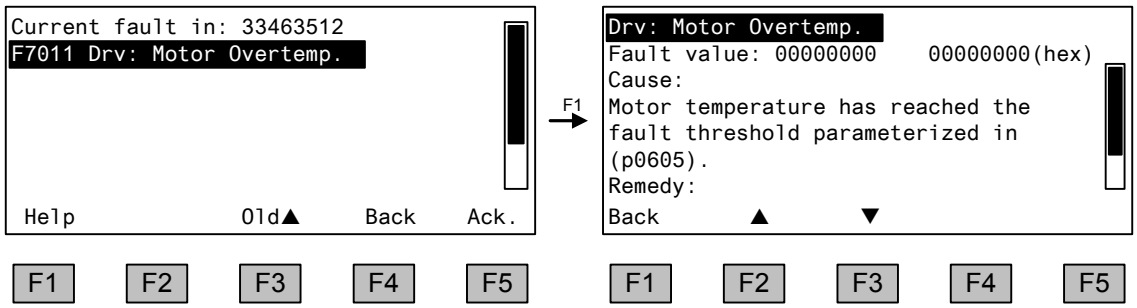


Fig. 6-30 Fault screen

To acknowledge a stored fault, choose F5 Ack.

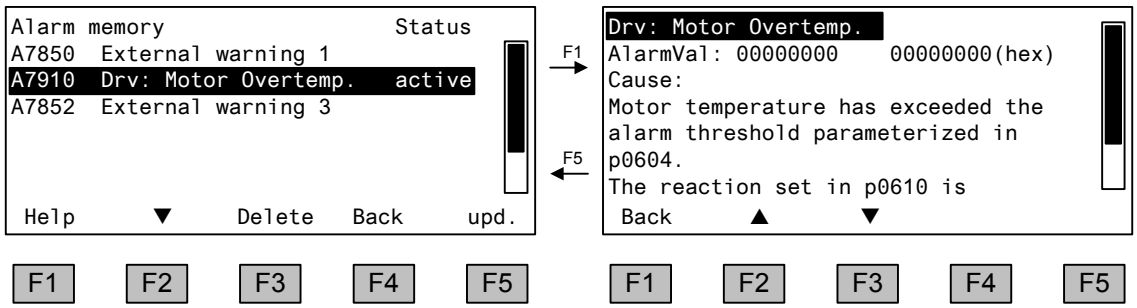


Fig. 6-31 Alarm screen

6.7.9 Saving the Parameters Permanently

Description

If parameters have been changed using the operator panel (confirm with OK in the Parameter Editor), the new values are initially stored in the volatile memory (RAM) of the converter. An "S" flashes in the top right of the AOP display until they are saved to a permanent memory. This indicates that at least 1 parameter has been changed and not yet stored permanently.

Two methods are available for permanently saving parameters that have been changed:

- The parameter list contains additional function key assignments. You can use the "<<" key to change the function of the keys. In the extended menu, you can save the data by choosing F3 "EEPROM".
- When confirming a parameter setting with OK, press the OK key for > 1 s. The system displays a message asking you whether the setting is to be saved in the EEPROM.
  If you press "Yes", the system saves the setting in the EEPROM. If you press "No", the setting is not saved permanently and the "S" starts flashing.

In both cases, **all** changes that have not yet been saved permanently are stored in the EEPROM.

6.7.10 Parameterization Errors

If an error occurs while parameters are being read or written, this is indicated in the status bar on the operator panel (the eighth or lowest line in the operation screen, or the seventh line in all other screens).

The system displays:

Parameter write error (d)pxxxx.yy:0xnn

and a plain-text explanation of the type of parameterization error.

■

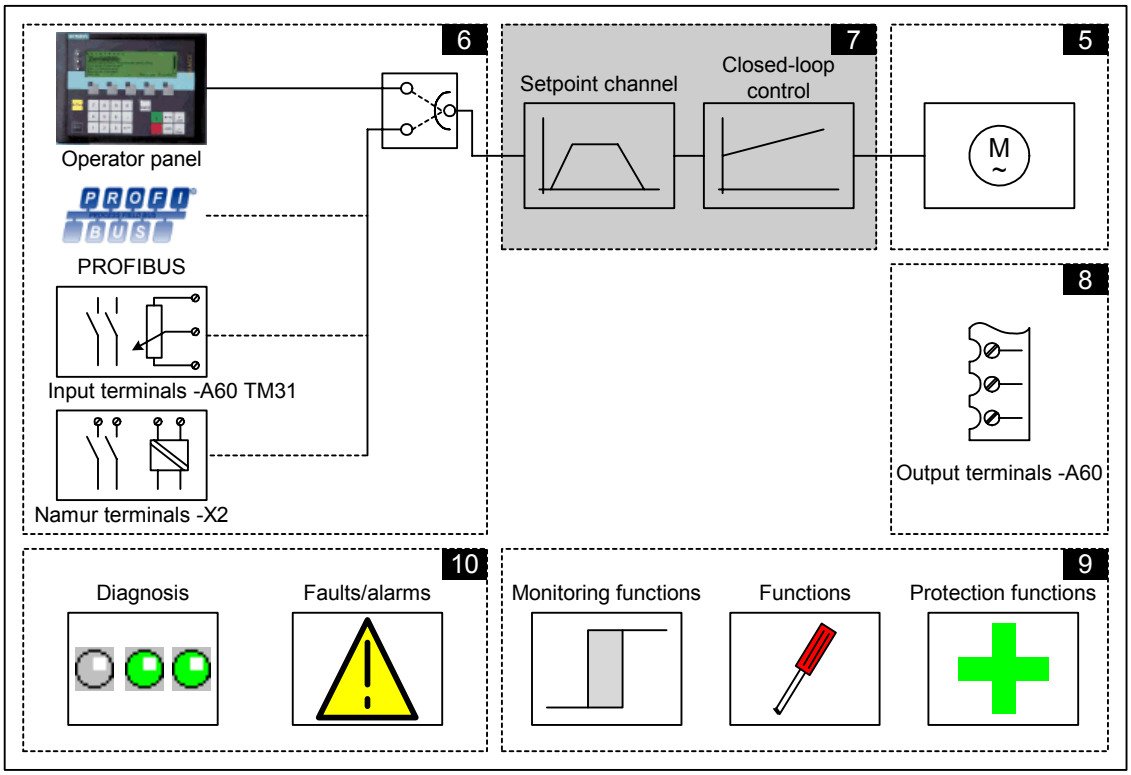
Setpoint Channel and Closed-Loop Control

7

7.1 Chapter Content

This chapter provides information on the setpoint channel and closed-loop control functions.

- Setpoint channel
  - Direction reversal
  - Suppression speed
  - Minimum speed
  - Speed limitation
  - Ramp-function generator
- V/f control
- Speed control with / without encoder



Function Diagrams

To supplement this operating manual, the documentation folder contains simplified function diagrams describing the operating principle of the SINAMICS G150. The diagrams are arranged in accordance with the chapters in the operating manual. The page numbers (7xx) describe the functionality in the following chapter.

At certain points in this chapter, reference is made to function diagrams with a 4-digit number. These are stored on the documentation CD in the "SINAMICS G List Manual", which provides experienced users with detailed descriptions of all the functions.

7.2 Setpoint Channel

7.2.1 Setpoint Addition

Description

The supplementary setpoint can be used to enter correction values from higher-level closed-loop controls. This can be implemented using the summing point of the main/supplementary setpoint in the setpoint channel. Both variables are imported simultaneously via two separate or one setpoint source and added in the setpoint channel.

Function Diagram

FD 3030

Parameters

- p1070 Main setpoint
- p1071 Main setpoint scaling
- r1073 Main setpoint effective
- p1075 Suppl setpoint
- p1076 Supplementary setpoint scaling
- r1077 Supplementary setpoint effective
- r1078 Total setpoint effective

7.2.2 Direction of Rotation Changeover

Description

If an incorrect phase sequence was connected when the cables were installed, and the phase sequence cannot be corrected by swapping the motor cables, it can be corrected by means of a negative command value or by parameterizing the cabinet unit, thereby enabling the direction to be reversed.

This is mainly used for operating the drive in both directions of rotation.

Requirements

Direction of rotation changeover is triggered:

- via PROFIBUS by means of control word 1, bit 11
- via the cabinet operator panel (LOCAL mode) with the "direction of rotation changeover" key.

NOTE

Only one direction of rotation is enabled in the factory setting.

Function Diagram

FD 3040

Parameters

- p1110 Inhibit negative direction
- p1111 Inhibit positive direction
- p1113 Direction reversal

7.2.3 Suppression Speed and Minimum Speed

Description

Variable-speed drives can generate critical whirling speeds within the control range of the entire drive train. This prevents steady-state operation in their proximity; in other words, although the drive can pass through this range, it must not remain within it because resonant oscillations may be excited. The suppression bandwidths allow this range to be blocked for steady-state operation. Because the points at which critical whirling speeds occur in a drive train can vary depending on age or thermal factors, a broader control range must be blocked. To ensure that the speed does not constantly increase and decrease in the suppression bandwidth (speeds), the bands are assigned a hysteresis.

Specifying a minimum speed allows a specific range to be disabled about speed 0 1/min for steady-state operation.

Signal Flow Diagram

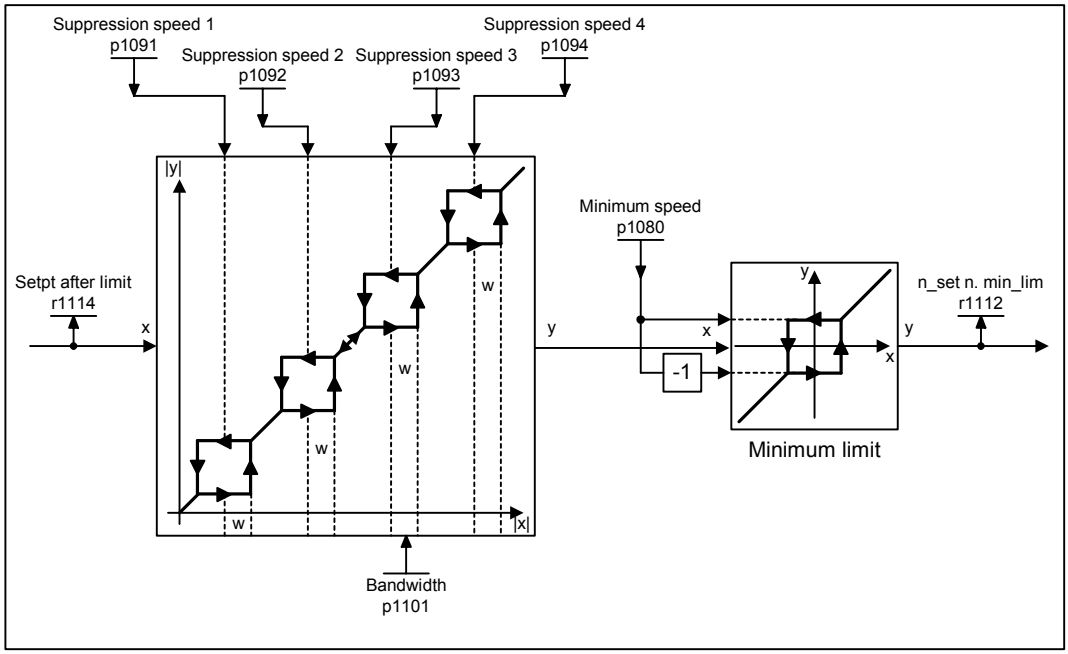


Fig. 7-1 Signal flow diagram: suppression speeds and minimum speeds

Function Diagram

FD 1550, 3050

Parameters

- p1091 Skip speed 1
- p1092 Skip speed 2
- p1093 Skip speed 3
- p1094 Skip speed 4
- p1101 Skip speed bandwidth
- p1080 Minimum speed
- r1112 Speed setpoint after minimum limiting

7.2.4 Speed Limitation

Description

Speed limitation aims to limit the maximum permissible speed of the entire drive train to protect the drive and load machine/process against damage caused by excessive speeds.

Signal Flow Diagram

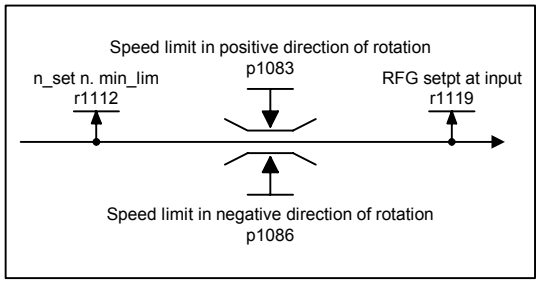


Fig. 7-2 Signal flow diagram: Speed limitation

Function Diagram

FD 1550, 3050

Parameters

- p1082 Maximum speed
- p1083 Speed limit in positive direction of rotation
- p1086 Speed limit negative direction of rotation

7.2.5 Ramp-Function Generator

Description

The ramp-function generator limits the rate at which the setpoint changes when the drive is accelerating or decelerating. This prevents excessive setpoint step changes from damaging the drive train. Additional rounding times can also be set in the lower and upper speed ranges to improve control quality and prevent load surges, thereby protecting mechanical components, such as shafts and couplings.

The ramp-up and ramp-down times each refer to the maximum speed (p1082). The rounding times that can be set can prevent the actual speed value from being overshot when the setpoint is approached, thereby improving control quality.

Notice: if rounding times are too long, this can cause the setpoint to be overshot if the setpoint is reduced abruptly during ramp-up. Rounding is also effective in the zero crossover; in other words, when the direction is reversed, the ramp-function generator output is reduced to zero via initial rounding, the ramp-down time, and final rounding before the new, inverted setpoint is approached via start rounding, the ramp-up time, and end rounding. Rounding times that can be set separately are active in the event of a fast stop (OFF3). The actual ramp-up/ramp-down times increase with active rounding.

Signal Flow Diagram

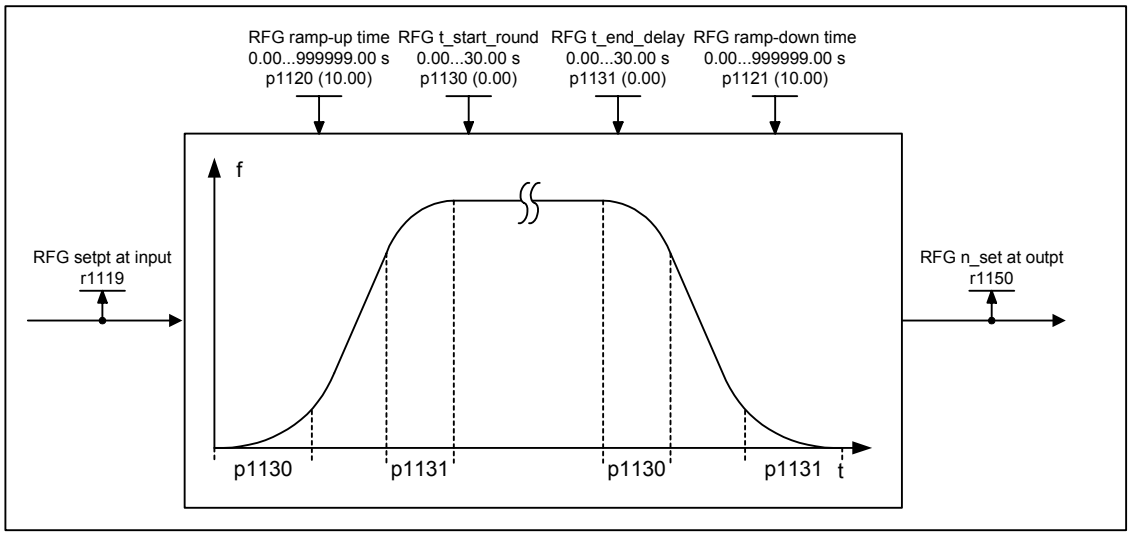


Fig. 7-3 Signal flow diagram: ramp-function generator

Function Diagram

FD 3060, 3070

Parameters

- p1120 Ramp-function generator ramp-up time
- p1121 Ramp-function generator ramp-down time
- p1130 Ramp-function generator initial rounding-off time
- p1131 Ramp-function generator final rounding-off time
- p1135 OFF3 ramp-down time
- p1136 OFF3 initial rounding-off time
- p1137 OFF3 final rounding-off time

NOTE

The effective ramp-up time increases when you enter an initial and final rounding-off time.

Effective ramp-up time = p1120 + (0.5 x p1130) + (0.5 x p1131)

7.3 V/f Control

Description

The simplest solution for a control procedure is the V/f characteristic, whereby the stator voltage for the induction motor or synchronous motor is controlled proportionately to the stator frequency. This method has proved successful in a wide range of applications with low dynamic requirements, such as:

- Pumps and fans
- Belt drives
- Multi-motor drives

and other similar processes.

V/f control aims to maintain a constant flux Φ in the motor, whereby the flux is proportional to the magnetization current (Iμ) or the ratio of voltage (U) to frequency (f).

$\Phi \sim I\mu \sim U/f$

The torque (M) generated by the induction motors is, in turn, proportional to the product (or, more precisely, the vector product (Φ x I)) of the flux and current.

To generate as much torque as possible with a given current, the motor must function using the greatest possible constant flux. To maintain a constant flux (Φ), therefore, the voltage must be changed in proportion to the frequency (f) to ensure a constant magnetization current (Iμ). V/f characteristic control is derived from these basic premises.

The field-weakening range is above the rated motor frequency, where the maximum voltage is reached. The flux and maximum torque are reduced as the frequency increases (see Fig. 7-4).

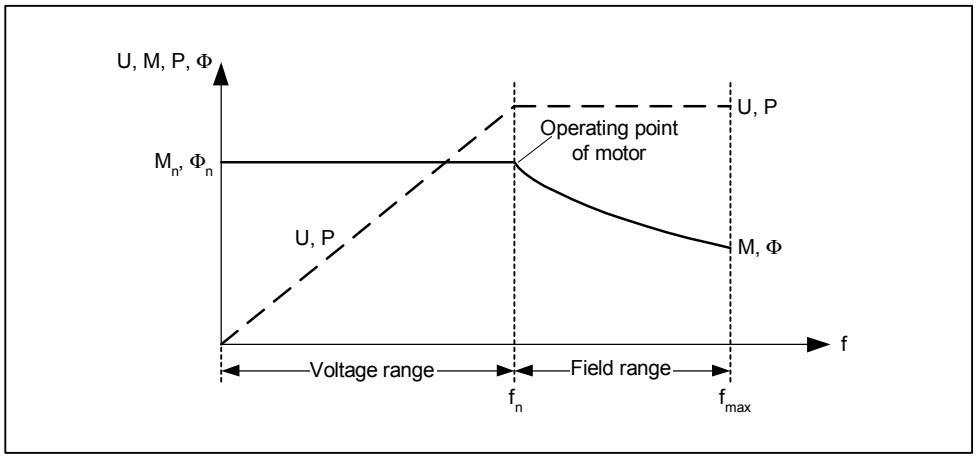
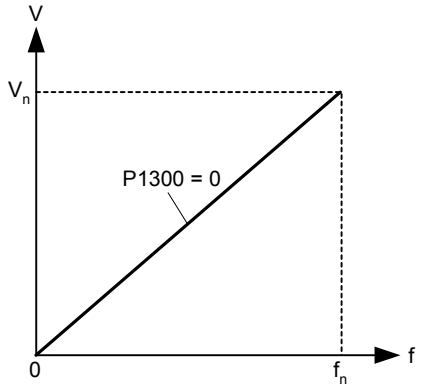
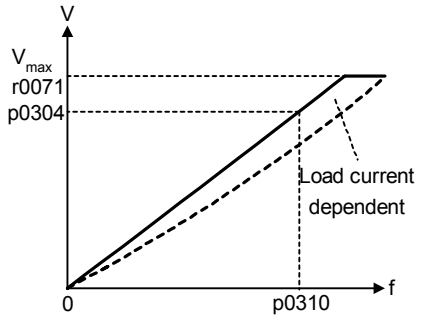
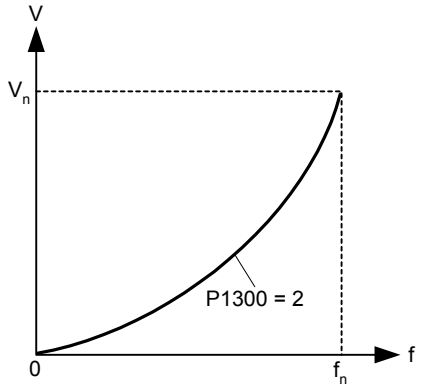
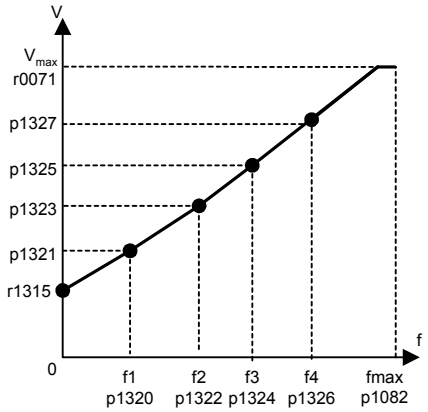


Fig. 7-4 Operating areas and characteristic curves for the induction motor with converter supply

Several variations of the V/f characteristic exist, which are listed in the following table.

Table 7-1 p1300 V/f characteristics

Parameter values	Meaning	Application / Property	
0	Linear characteristic	Standard with variable voltage boost	
1	Linear characteristic with flux current control (FCC)	Characteristic that compensates for voltage drops in the stator resistance for static / dynamic loads (flux current control FCC). This is particularly useful for small motors, since they have a relatively high stator resistance.	
2	Parabolic characteristic	Characteristic that takes into account the motor torque curve (e.g. fan/pump). • Quadratic characteristic (f^2 characteristic) • Energy saving because the low voltage also results in small currents and drops.	

Parameter values	Meaning	Application / Property	
3	Programmable characteristic	Characteristic that takes into account motor/machine torque curve	
5	Precise frequency drives	Characteristic (see parameter value 0) that takes into account the technological particularity of an application (e.g. textile applications): • Whereby the current limitation (Imax controller) only affects the output voltage and not the output frequency. • By disabling slip compensation.	
6	Precise frequency drives with flux current control (FCC)	Characteristic (see parameter value 1) that takes into account the technological particularity of an application (e.g. textile applications): • Whereby the current limitation (Imax controller) only affects the output voltage and not the output frequency. • By disabling slip compensation. Voltage drops in the stator resistance for static / dynamic loads are also compensated (flux current control FCC). This is particularly useful for small motors, since they have a relatively high stator resistance.	
19	Independent voltage setpoint	The user can define the output voltage of the power module independently of the frequency using BICO parameter p1330 via the interfaces (e.g. analog input AI0 of the TM31 –> p1330 = r4055[0]).	

Function Diagram

FD 1665, 6300

Parameter

- p1300 Open-loop/closed-loop control operating mode

7.3.1 Voltage Boost

Description

With low output frequencies, the V/f characteristics yield only a small output voltage.

With low frequencies, too, the ohmic resistance of the stator windings has an effect and can no longer be ignored vis-à-vis the machine reactance. With low frequencies, therefore, the magnetic flux is no longer proportional to the magnetization current or the V/f ratio.

The output voltage may, however, be too low in order to:

- Magnetize the induction motor.
- Maintain the load.
- Compensate for the voltage drops (ohmic losses in the winding resistors) in the system
- Generate a breakaway/acceleration/braking torque.

You can choose whether the voltage boost is to be active permanently or only during acceleration.

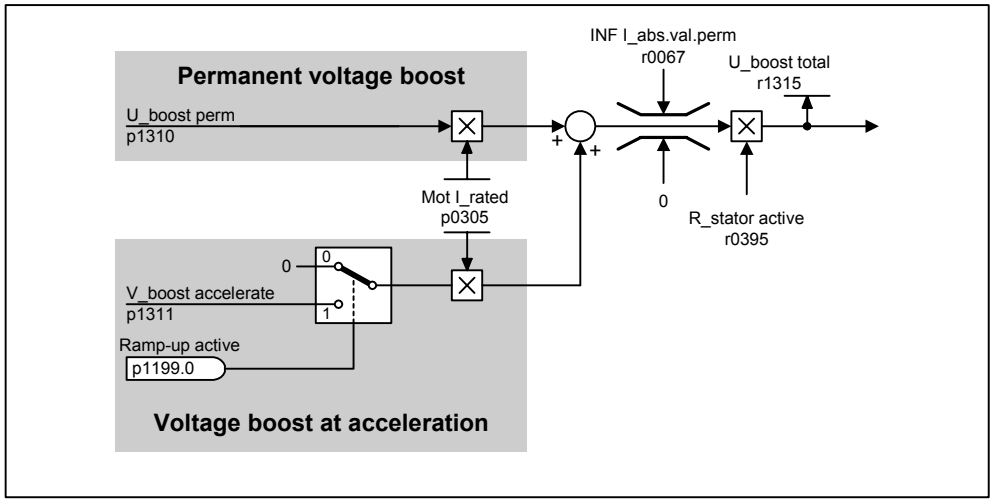


Fig. 7-5 Total voltage boost

NOTE

The voltage boost affects all V/f characteristics (p1300) from 0 to 6.

IMPORTANT

If the voltage boost value is too high, this can result in a thermal overload of the motor winding.

Permanent Voltage Boost (p1310)

The voltage boost is active across the entire frequency range, whereby the value decreases continuously at higher frequencies.

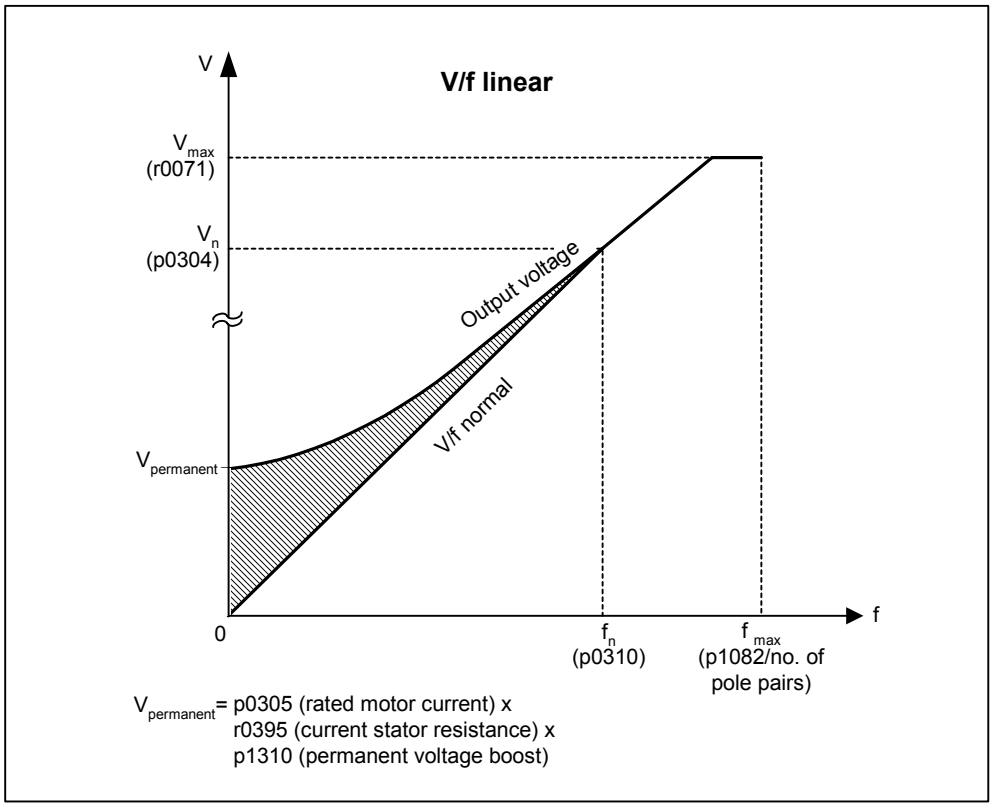


Fig. 7-6 Permanent voltage boost (example: p1300 = 0 and p1311 = 0)

Voltage Boost at Acceleration (p1311)

The voltage boost is only active during acceleration/braking.

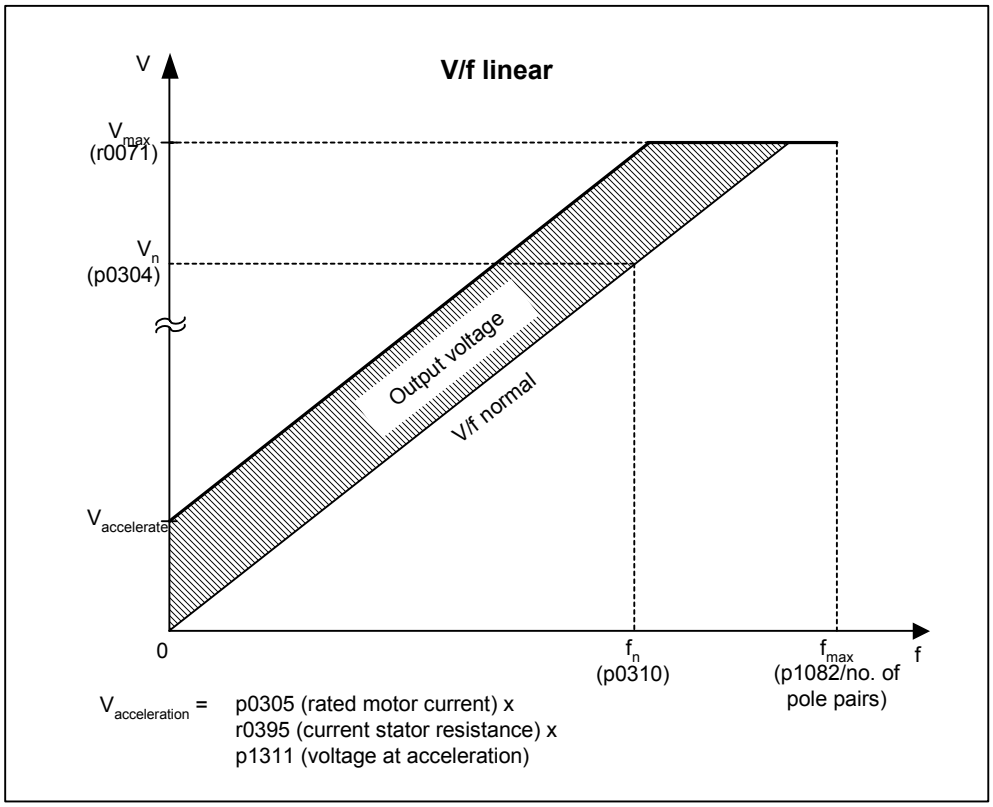


Fig. 7-7 Voltage boost at acceleration (example: p1300 = 0 and p1310 = 0)

Function Diagram

FD 1665, 6300

Parameters

- p0305 Rated motor current
- r0395 Stator resistance, actual
- p1310 Voltage boost permanent
- p1311 Voltage boost at acceleration
- r1315 Voltage boost total

7.3.2 Slip Compensation

Description

The slip compensation means that the speed of induction motors is essentially kept constant independent of the load.

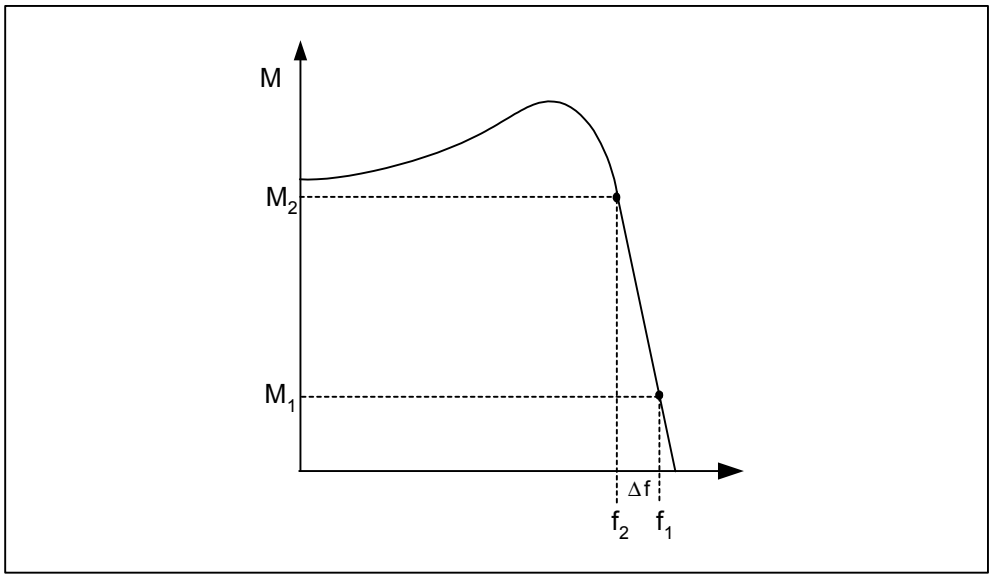


Fig. 7-8 Slip compensation

Function Diagram

FD 1665, 6310

Parameters

- p1335 Slip compensation
  - p1335 = 0.0 %: slip compensation is deactivated.
  - p1335 = 100.0 %: Slip is fully compensated.
- p1336 Slip compensation limit value
- r1337 Actual slip compensation

7.4 Vector Speed / Torque Control With / Without Encoder

Description

Compared with V/f control, vector control offers the following benefits:

- Stability vis-à-vis load and setpoint changes
- Short rise times with setpoint changes (–> better command behavior)
- Short settling times with load changes (–> better disturbance characteristic)
- Acceleration and braking are possible with maximum available torque
- Motor protection due to variable torque limitation in motor and regenerative mode
- Drive and braking torque controlled independently of the speed

These benefits are available without speed feedback.

Vector control can be used with or without an encoder.

The following criteria indicate when an encoder is required:

- Maximum speed accuracy is required
- Maximum dynamic response requirements
- Better command behavior
- Shortest settling times when disturbances occur
- Torque control in a range greater than 01:20:00 AM is required
- Allows a defined and/or variable torque for speeds below approx. 5% of the rated motor frequency (p0310) to be maintained.

With regard to setpoint input, vector control is divided into:

- Speed control
- Torque/current control (torque control)

7.4.1 Vector Control Without Sensor

Description

In vector control without an encoder (SLVC: Sensorless Vector Control), the position of the flux and actual speed must be determined via the electric motor model. The model is buffered by the incoming currents and voltages. At low frequencies (approx. 0 Hz), the model cannot determine the speed.

For this reason and due to uncertainties in the model parameters or inaccurate measurements, the system is switched from closed-loop to open-loop operation in this range.

The switchover is governed by time and frequency conditions (p1755, p1756, and p1758). The system does not wait for the time condition to elapse when the setpoint frequency at the ramp-function generator input and the actual frequency are below p1755 x (1 - p1756) simultaneously.

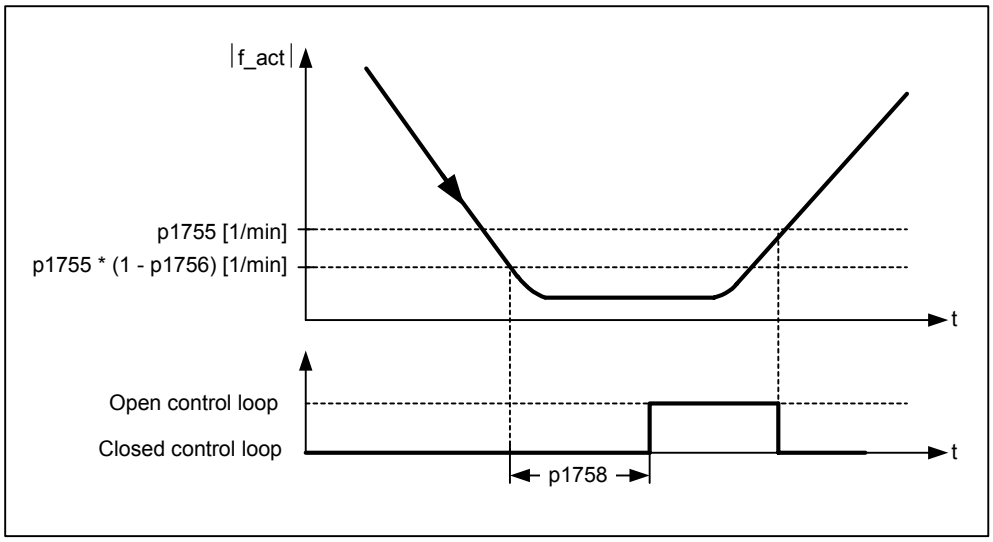


Fig. 7-9 Switchover conditions

In open-loop operation, the actual speed value is the same as the setpoint value. For vertical loads and acceleration, parameters p1610 (constant torque boost) and p1611 (acceleration torque boost) must be modified in order to generate the static or dynamic load torque of the drive. If p1610 is set to 0%, only the magnetizing current (r0331) is injected; when the value is 100%, the rated motor current (p0305) is injected. To ensure that the drive does not stall during acceleration, p1611 can be increased or acceleration pre-control for the speed controller can be used. This is also advisable to ensure that the motor is not subject to thermal overload at low speeds.

Vector control without a speed sensor has the following characteristics at low frequencies:

- Closed-loop operation up to approx. 1 Hz output frequency
- Start-up in closed-loop operation (directly after drive is energized)
- Passes through low frequency range (0 Hz) in closed-loop operation

---

NOTE

In this case, the speed setpoint upstream of the ramp-function generator must be greater than (p1755).

Closed-loop operation up to approx. 1 Hz (settable via parameter p1755) and the ability to start or reverse at 0 Hz directly in closed-loop operation (settable via parameter p1750) result in the following benefits:

- No switchover required within closed-loop control (smooth operation, no dips in frequency).
- Steady-state speed–torque control up to approx. 1 Hz.

NOTE

When the motor is started or reversed in closed-loop control at 0 Hz, it is important to take into account that a switchover is made from closed-loop to open-loop control automatically if the system remains in the 0 Hz range for too long (> 2 s or > p1758).

Function Diagram

FD 6730

Parameters

- p0305 Rated motor current
- r0331 Motor magnetizing current/short-circuit current
- p1610 Torque setpoint static (SLVC)
- p1611 Supplementary accelerating torque (SLVC)
- p1750 Motor model configuration
- p1755 Motor model changeover speed sensorless operation
- p1756 Motor model changeover speed hysteresis
- p1758 Motor model changeover delay time, closed/open-loop control

7.4.2 Vector Control with Encoder

Description

Benefits of vector control with an encoder:

- The speed can be controlled right down to 0 Hz (standstill)
- Stable control response throughout the entire speed range
- A defined and/or variable torque for speeds below approx. 10 % of the rated motor speed needs to be maintained.
- Compared with speed control without an encoder, the dynamic response of drives with an encoder is significantly better because the speed is measured directly and integrated in the model created for the current components.

Function Diagram

FD 1590, 1610, 6010, 6030, 6040, 6050, 6060, 6490

7.4.3 Speed Controller

Description

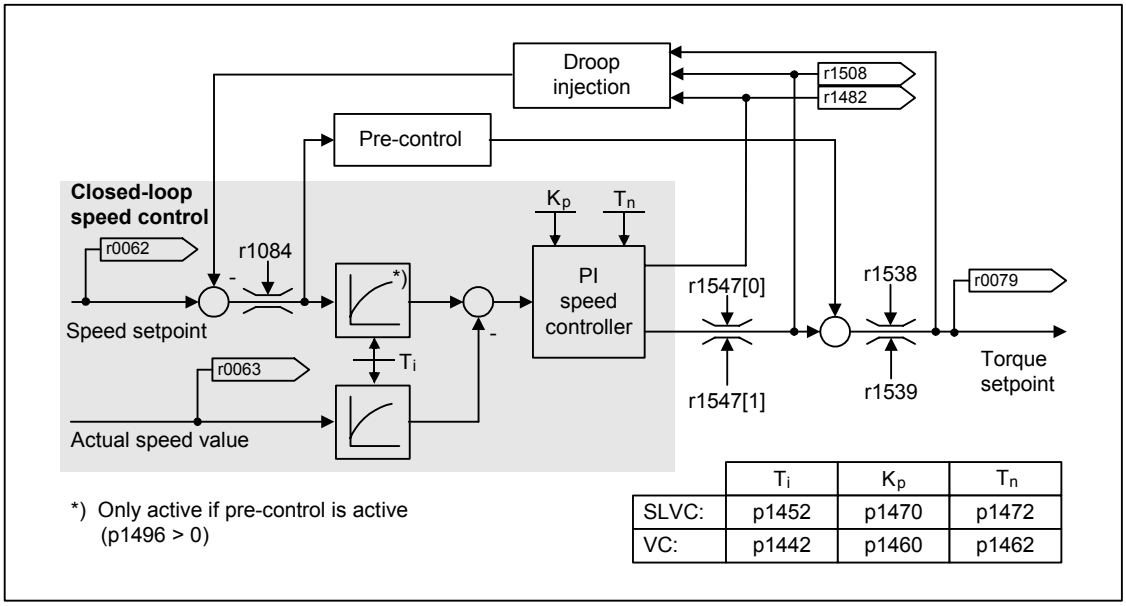
Both closed-loop control techniques with and without encoder (SLVC, VC) have the same speed controller structure that contains the following components as kernel:

- PI controller
- Speed controller pre-control
- Droop function

The total of the output variables result in the torque setpoint, which is reduced to the permissible magnitude by means of the torque setpoint limitation.

The speed controller receives its setpoint (r0062) from the setpoint channel and its actual value (r0063) either directly from the speed sensor (speed control with sensor (VC)) or indirectly via the motor model (speed control without sensor (SLVC)). The system difference is increased by the PI controller and, in conjunction with the pre-control, results in the torque setpoint.

When the load torque increases, the speed setpoint is reduced proportionately when the droop function is active, which means that the single drive within a group (two or more mechanically connected motors) is relieved when the torque becomes too great.



	T_i	K_p	T_n
SLVC:	p1452	p1470	p1472
VC:	p1442	p1460	p1462

Fig. 7-10 Speed controller

The optimum speed controller setting can be determined via the automatic speed controller optimization function (p1960).

If the inertia load has been specified, the speed controller (Kp, Tn) can be calculated by means of automatic parameterization (p0340 = 4). The controller parameters are defined in accordance with the symmetrical optimum as follows:

Tn = 4 x Ts

Kp = 0.5 x r0345 / Ts = 2 x r0345 / Tn

Ts = sum of the short delay times (includes p1442 and p1452).

If vibrations occur with these settings, the speed controller gain Kp must be reduced manually. Actual speed value smoothing can also be increased (standard procedure for gearless or high-frequency torsion vibrations) and the controller calculation performed again because this value is also used to calculate Kp and Tn.

The following relationships apply for optimization:

- If Kp is increased, the controller becomes faster, although overshoot is reduced. Signal ripples und vibrations in the speed control loop, however, increase.
- If Tn is decreased, the controller still becomes faster, although overshoot is increased.

When setting speed control manually, you are advised to define the dynamic response via Kp (and actual speed value smoothing) so that the integral time can be reduced as much as possible. When doing so, closed-loop control must also remain stable in the field-weakening range.

To suppress any vibrations that occur in the speed controller, it is usually only necessary to increase the smoothing time in p1442 or p1452 or reduce the controller gain.

The integral output of the speed controller can be monitored via r1482 and the limited controller output via r1508 (torque setpoint).

NOTE

When compared to closed-loop speed control with encoder, the dynamic performance for sensorless drives is significantly lower. The actual speed is derived – using a model-based calculation – from the drive converter output quantities current and voltage. These current and voltage signals are noisy. This means that the actual speed must be filtered using appropriate filter algorithms in the software.

Function Diagram

FD 6040

Parameters

- p0340 Automatic calculation of motor/closed-loop control parameters
- p1442 Speed actual value smoothing time (VC)
- p1452 Speed actual value smoothing time (SLVC)
- p1460 Speed controller P gain adaptation speed, lower
- p1462 Speed controller integral action time adaptation speed, lower
- p1470 Speed controller sensorless operation P-gain
- p1472 Speed controller sensorless operation integral-action time
- p1960 Speed controller optimization selection
- r0062 CO: Speed setpoint after the filter
- r0063 CO: Actual speed, smoothed
- r0345 CO: Rated motor start-up time
- r1482 CO: Torque output I speed controller
- r1508 CO: Torque setpoint before supplementary torque

7.4.3.1 Speed controller pre-control (integrated pre-control with balancing)

Description

The command behavior of the speed control loop can be improved by calculating the accelerating torque from the speed setpoint and connecting it on the line side of the speed controller. This torque setpoint mv is applied to the current controller/the current controller is pre-controlled using adaptation elements directly as additive reference variable (enabled via p1496).
The torque setpoint mv is calculated from:

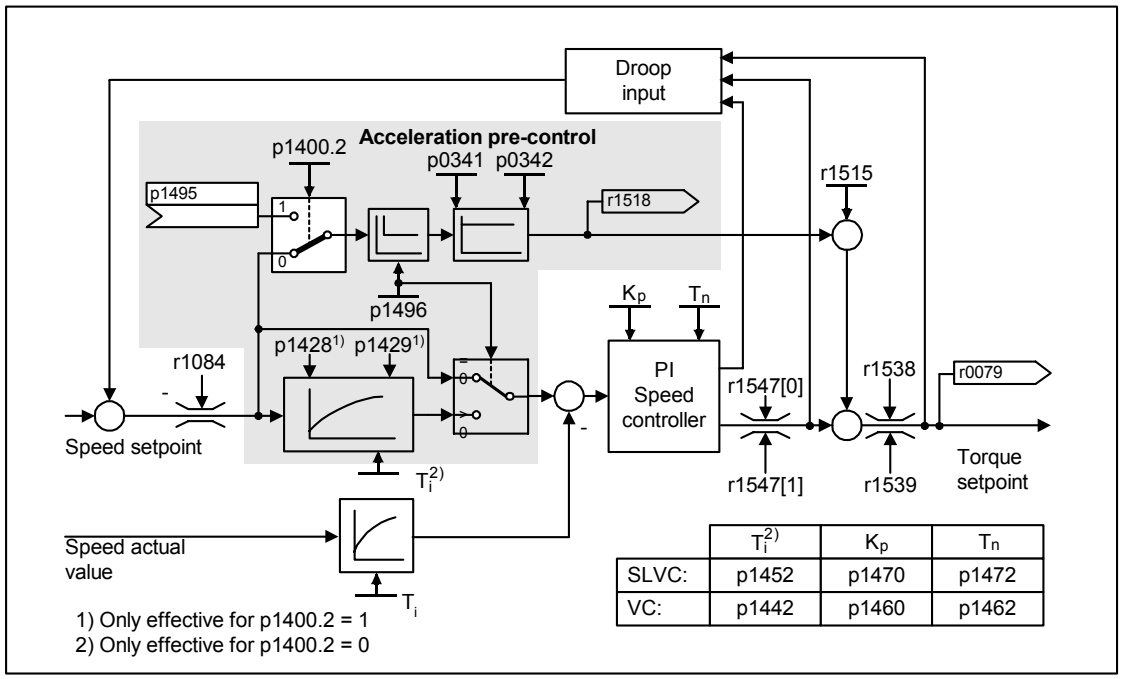
$$mv = p1496 \cdot J \cdot \frac{dn}{dt} = p1496 \cdot p0341 \cdot p0342 \cdot \frac{dn}{dt}$$

The motor moment of inertia p0341 is calculated when commissioning the drive system. The factor p0342 between the total moment of inertia J and the motor moment of inertia must be determined manually or by optimizing the speed controller. The acceleration is calculated from the speed difference over the time dn/dt.

NOTE

When speed controller optimization is carried out, the ratio between the total moment of inertia and that of the motor (p0342) is determined and acceleration pre-control scaling (p1496) is set to 100 %.

If p1400.2 = p1400.3 = 0, then the pre-control balancing is automatically set.



	$T_i^{2)}$	K_p	T_n
SLVC:	p1452	p1470	p1472
VC:	p1442	p1460	p1462

Fig. 7-11 Speed controller with pre-control

When correctly adapted, when accelerating, the speed controller must compensate for disturbances in its control loop. This is achieved with a relatively low controlled variable change at the controller output. On the other hand, speed setpoint changes are routed past the speed controller and are therefore more quickly executed.

The effect of the pre-control variable can be adapted according to the application via the evaluation factor p1496. For p1496 = 100 %, the pre-control is calculated according to the motor and load moment of inertia (p0341, p0342). In order that the speed controller does not work against the entered torque setpoint, a balancing filter is automatically used. The time constant of the balancing filter corresponds to the equivalent delay time of the speed control loop. The speed controller pre-control is correctly set (p1496 = 100 %, calibration using p0342) if the I component of the speed controller (r1482) does not change while ramping-up or ramping-down in the range n > 20 % x p0310. Thus, the pre-control allows a new speed setpoint to be approached without overshoot (prerequisite: the torque limiting does not act and the moment of inertia remains constant).

If the speed controller is pre-controlled through injection, the speed setpoint (r0062) is delayed with the same smoothing time (p1442 or p1452) as the actual value (r1445). This ensures that no target/actual difference (r0064) occurs at the controller input during acceleration, which would be attributable solely to the signal propagation time.

When speed pre-control is activated, the speed setpoint must be specified continuously or without a higher interference level (avoids sudden torque changes). An appropriate signal can be generated by smoothing the setpoint or activating the rounding-off function of the ramp-function generator p1130 - p1131.

The starting time r0345 (T_{start}) is a measure for the total moment of inertia J of the motor and defines that time in which the unloaded drive can accelerate from standstill up to the rated motor speed p0311 ($M_{mot,rated}$) with the rated motor torque r0333 ($n_{mot,rated}$).

$$r0345 = T_{start} = J \cdot \frac{2\pi \cdot n_{mot,rated}}{60 \cdot M_{mot,rated}} = p0341 \cdot p0342 \cdot \frac{2\pi \cdot p0311}{60 \cdot r0333}$$

If these basic conditions are in line with the application, the starting time can be used as the lowest value for the ramp-up or ramp-down time.

NOTE

The ramp-up and ramp-down times (p1120; p1121) of the ramp-function generator in the setpoint channel should be set accordingly so that the motor speed can track the setpoint during acceleration and braking. This ensures that speed controller pre-control is functioning optimally.

The acceleration pre-control using a connector input (p1495) is activated by the parameter settings p1400.2 = 1 and p1400.3 = 0. p1428 (dead time) and p1429 (time constant) can be set for balancing purposes.

Function diagram

FP 6031

Parameters

- p0311 Rated motor speed
- r0333 Rated motor torque
- p0341 Motor moment of inertia
- p0342 Ratio between the total and motor moment of inertia
- r0345 Nominal motor starting time
- p1400.2 Acceleration pre-control source
- p1428 Speed pre-control balancing deadtime
- p1429 Speed pre-control balancing time constant
- p1496 Acceleration pre-control scaling
- r1518 Accelerating torque

7.4.3.2 Reference model

Description

The reference model becomes operative when p1400.3 = 1 and p1400.2 = 0.

The reference model is used to emulate the speed control loop with a P speed controller.

The loop emulation can be set in p1433 to p1435. It becomes effective if p1437 is connected to the output of the model r1436.

The reference model delays the setpoint-actual value deviation for the integral component of the speed controller so that settling (stabilizing) operations can be suppressed.

The reference model can also be externally emulated and the external signal entered via p1437.

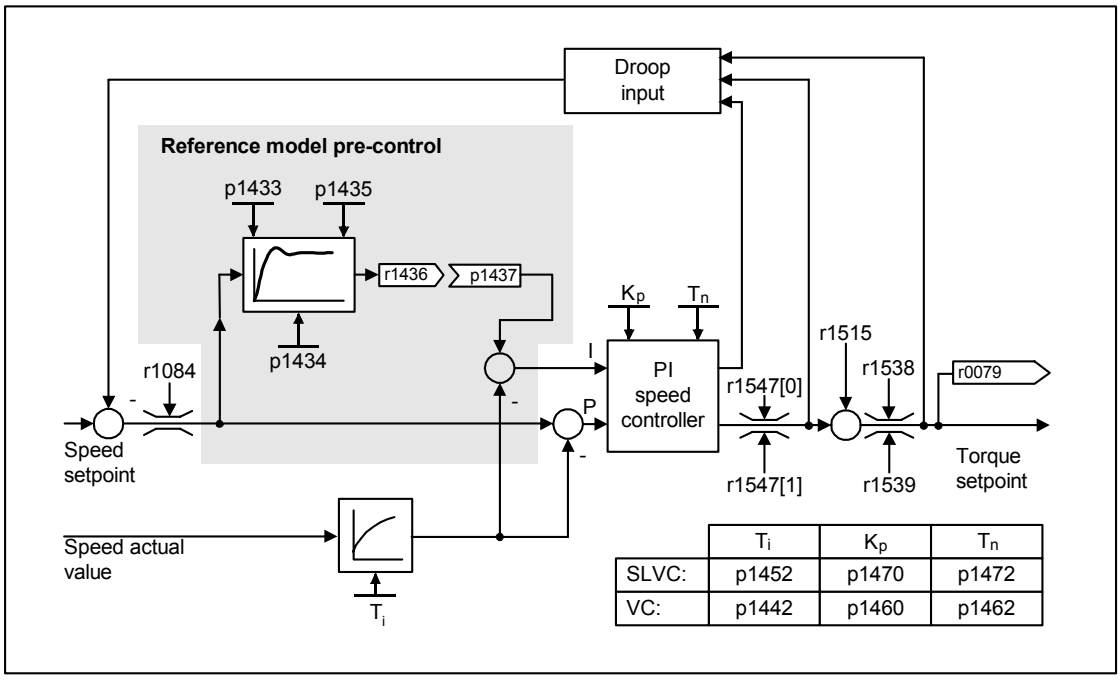


Fig. 7-12 Reference model

Function diagram

FP 6031

Parameters

- p1400.3 Reference model, speed setpoint, I component
- p1433 Speed controller reference model natural frequency
- p1434 Speed controller reference model damping
- p1435 Speed controller reference model deadtime
- p1436 Speed controller reference model speed setpoint output
- p1437 Speed controller, reference model I component input

7.4.3.3 Speed controller adaptation

Description

Two adaptation methods are available, namely free Kp_n adaptation and speed-dependent Kp_n/Tn_n adaptation.

Free Kp_n adaptation is also active in "operation without encoder" mode and is used in "operation with encoder" mode as an additional factor for speed-dependent Kp_n adaptation.

Speed-dependent Kp_n/Tn_n adaptation is only active in "operation with encoder" mode and also affects the Tn_n value.

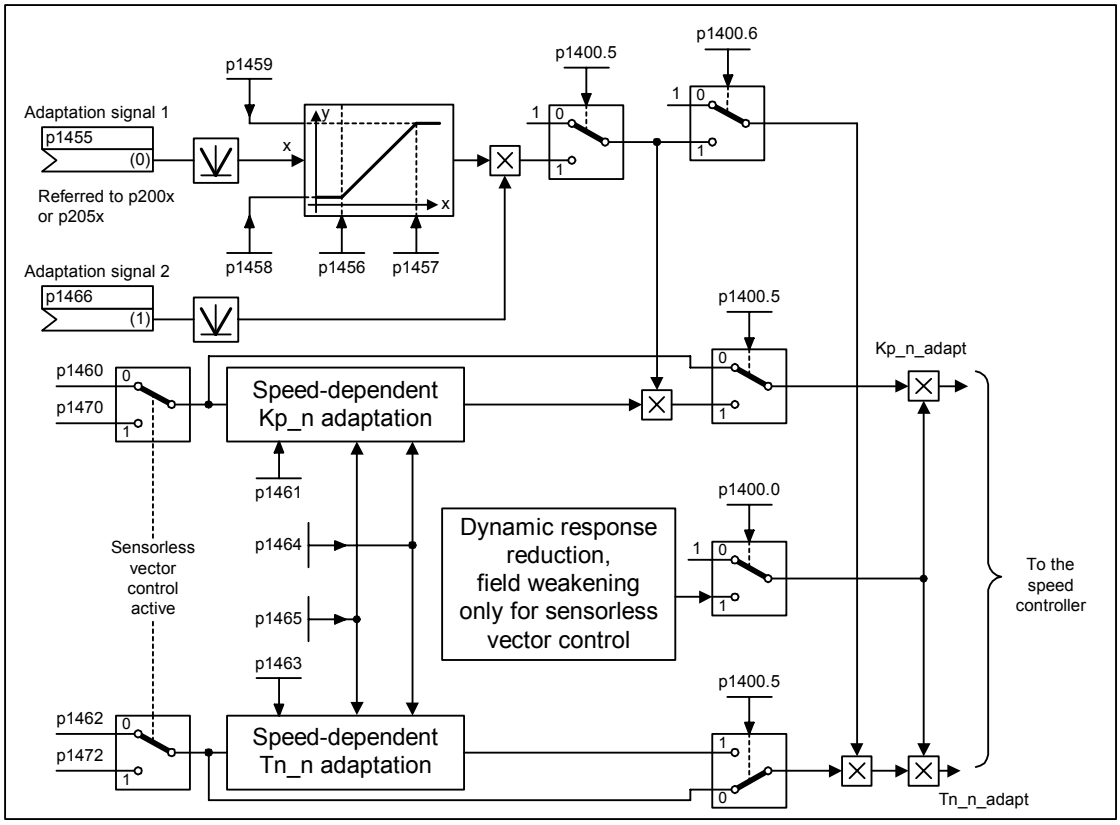


Fig. 7-13 Free Kp adaptation

A dynamic response reduction in the field-weakening range can be activated (p1400.0) in sensorless operation. This is activated when the speed controller is optimized in order to achieve a greater dynamic response in the basic speed range.

Example of speed-dependent adaptation

NOTE

This type of adaptation is only active in "operation with encoder" mode.

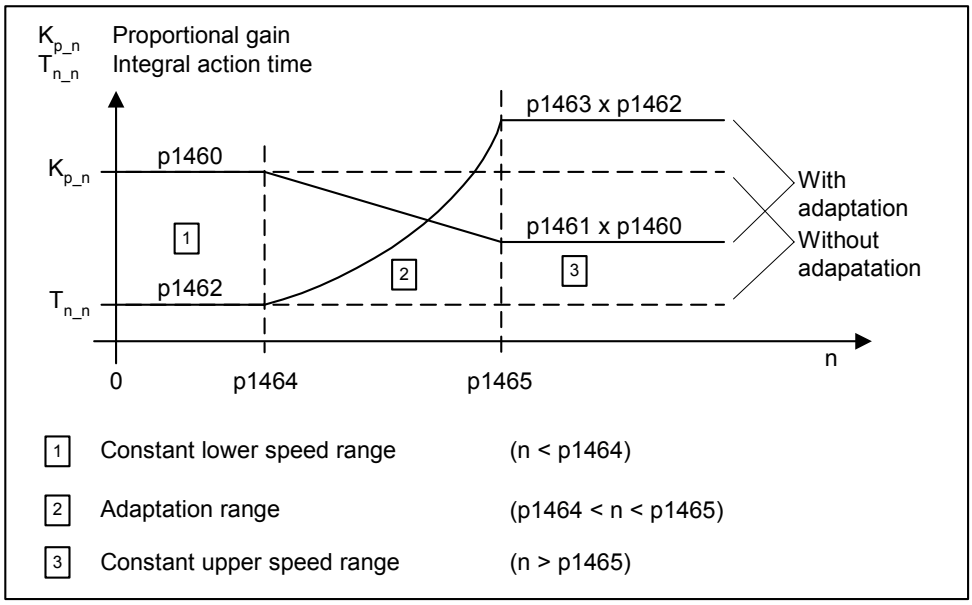


Fig. 7-14 Free Kp adaptation

Function diagram

FP 6050

Parameters

- p1400.5 Speed control configuration: Kp/Tn adaptation active

Free Kp_n adaptation

- p1455 Speed controller P gain adaptation signal
- p1456 Speed controller P gain adaptation lower starting point
- p1457 Speed amplifier, P gain adaptation upper starting point
- p1458 Adaptation factor, lower
- p1459 Adaptation factor, upper
- p1470 Speed controller sensorless operation P-gain

Speed-dependent Kp_n/Tn_n adaptation (VC only)

- p1460 Speed controller P gain adaptation speed, lower
- p1461 Speed controller P gain adaptation speed, upper
- p1462 Speed controller integral action time adaptation speed, lower
- p1463 Speed controller integral action time adaptation speed, upper
- p1464 Speed controller adaptation speed, lower
- p1465 Speed controller adaptation speed, upper
- p1466 Speed controller P-gain scaling

Dynamic response reduction field weakening (SLVC only)

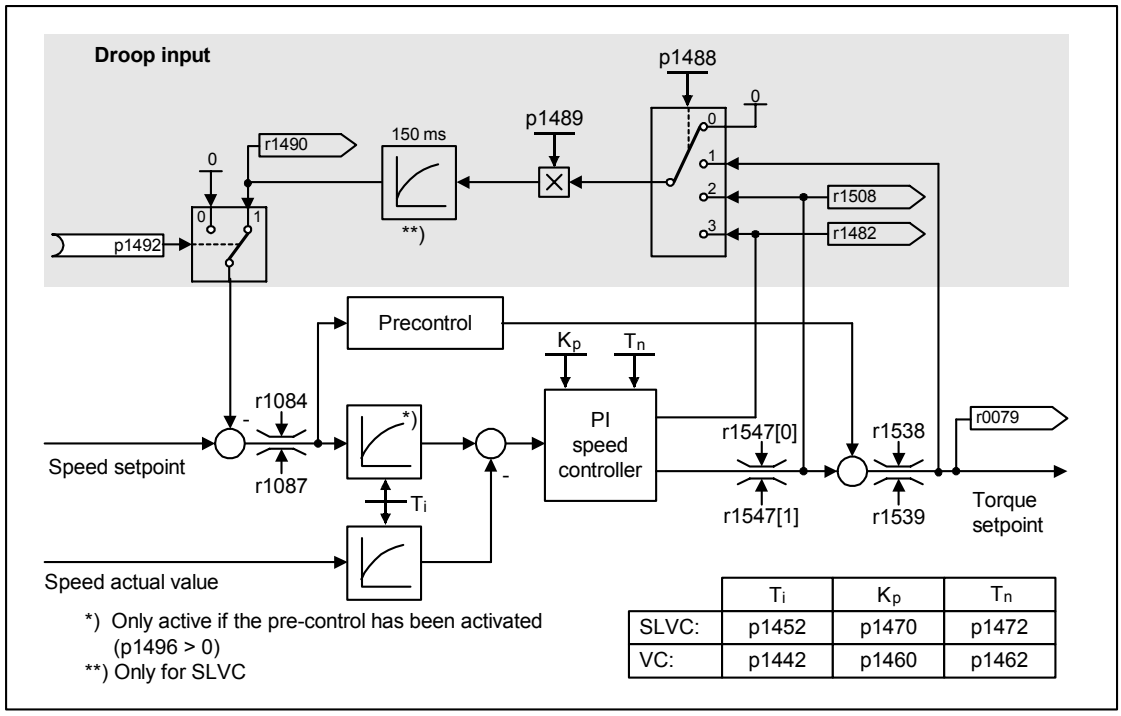
- p1400.0 Speed control configuration: Automatic Kp/Tn adaptation active

7.4.3.4 Droop Function

Description

The droop function (enabled via p1492) ensures that the speed setpoint is reduced proportionately as the load torque increases.

Drooping is the most straightforward way of controlling load balancing. This type of control can only be applied, however, if the drives are operated in motor mode and the speed is more or less constant. This method is only suitable to a limited extent for drives that are accelerated and braked with significant changes in speed. This simple type of load balancing control is used, for example, in applications in which two or more motors are connected mechanically or operate with a common shaft and fulfill the above requirements. In this case, the droop compensates/corrects torque differences that can occur as a result of the mechanical coupling by appropriately modifying the speeds of the individual motors (individual drive is relieved when the torque becomes too great).



	Ti	Kp	Tn
SLVC:	p1452	p1470	p1472
VC:	p1442	p1460	p1462

Fig. 7-15 Speed controller with droop

Requirements

- All drives must be operated with vector and speed control (with or without speed sensor).
- The ramp-up/ramp-down times of the ramp-function generator must be identical for all drives.

Function Diagram

FD 6030

Parameters

- r0079 Total speed setpoint
- p1492 Enable droop
- r1482 Speed controller I torque output
- p1488 Droop input source
- p1489 Droop feedback scaling
- r1490 Droop feedback speed reduction
- r1508 Torque setpoint before supplementary torque

7.4.4 Closed-loop torque control

Description

For sensorless closed-loop speed control (p1300 = 20) or closed-loop speed control with encoder VC (p1300 = 21), it is possible to change over to closed-loop torque control using BICO parameter p1501. It is not possible to change over between closed-loop speed and torque control if closed-loop torque control is directly selected with p1300 = 22 or 23. The torque setpoint and/or supplementary setpoint can be entered using BICO parameter p1503 (CI: torque setpoint) or p1511 (CI: supplementary torque setpoint). The supplementary torque acts both for closed-loop torque as well as for the closed-loop speed control. As a result of this characteristic, a pre-control torque can be implemented for the closed-loop speed control using the supplementary torque setpoint.

NOTE

For safety reasons, assignments to fixed torque setpoints are currently not possible.

If energy is regenerated and cannot be injected back into the line supply, then a Braking Module with connected braking resistor must be used.

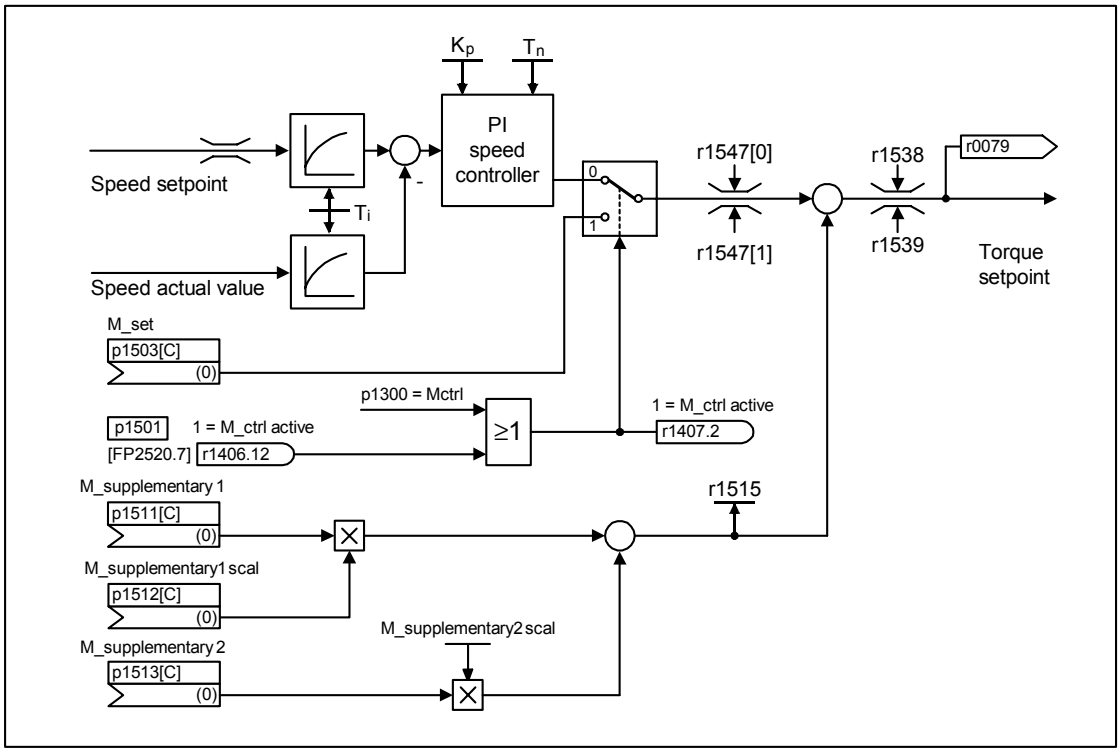


Fig. 7-16 Closed loop speed/torque control

The total of the two torque setpoints is limited in the same way as the speed control torque setpoint. Above the maximum speed (p1082), a speed limiting controller reduces the torque limits in order to prevent the drive from accelerating any further.

A "real" closed-loop torque control (with a speed that automatically sets itself) is only possible in the closed-loop control range but not in the open-loop control range of the sensorless closed-loop vector control. In the open-loop controlled range, the torque setpoint changes the setpoint speed via a ramp-up integrator (integrating time ~ p1499 x p0341 x p0342). This is the reason that sensorless closed-loop torque control close to standstill is only suitable for applications that require an accelerating torque there and no load torque (e.g. traversing drives). Closed-loop torque control with encoder does not have this restriction.

If a quick stop command (OFF3) is issued when torque control is active, a switchover is made automatically to speed control and the drive is decelerated. For closed-loop torque control (p1501 = 1), when a stop command is issued (OFF1) a changeover is not made. Instead, the system waits until a higher-level closed-loop control decelerates the drive to a standstill so that the pulses can be inhibited. This is necessary in order to allow master and slave drives to stop together in a coordinated fashion.

For p1300 = 22 or 23, when an OFF1 is issued, then the drive is drive is directly powered-down (the same as for OFF2).

Function diagram

FP 6060

Parameters

- p0341 Motor moment of inertia
- p0342 Ratio between the total and motor moment of inertia
- p1300 Open-loop/closed-loop control mode
- p1499 Accelerating for torque control, scaling
- p1501 Change over between closed-loop speed/torque control
- p1503 Torque setpoint
- p1511 Supplementary torque 1
- p1512 Supplementary torque 1 scaling
- p1513 Supplementary torque 2
- p1514 Supplementary torque 2 scaling
- r1515 Supplementary torque total

7.4.5 Torque limiting

Description

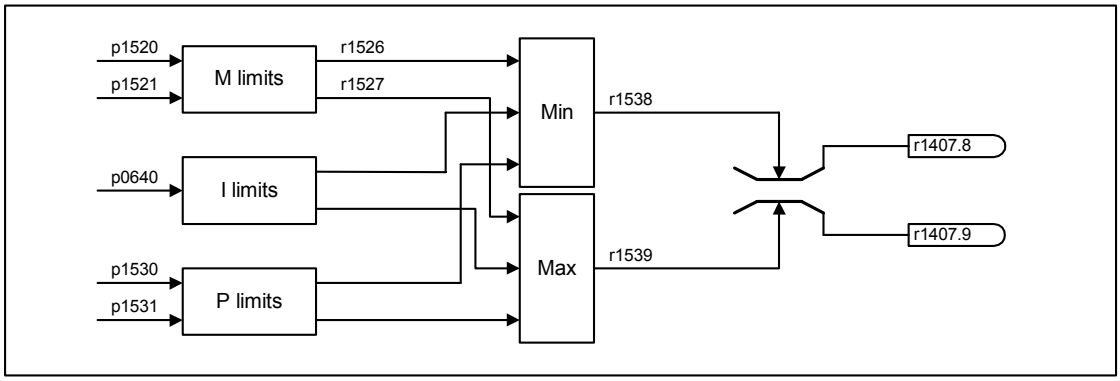


Fig. 7-17 Torque limiting

The value specifies the maximum permissible torque whereby different limits can be parameterized for motor and regenerative mode.

- p0640 Current limit
- p1520 Torque limit, upper/motoring
- p1521 Torque limit, lower/regenerative
- p1522 Torque limit, upper/motoring
- p1523 Torque limit, lower/regenerative
- p1524 Torque limit, upper/motoring, scaling
- p1525 Torque limit, lower/regenerating scaling
- p1530 Power limit, motoring
- p1531 Power limit, regenerating

The currently active torque limit values are displayed in the following parameters:

- r0067 Maximum drive output current
- r1526 Torque limit, upper/motoring without offset
- r1527 Torque limit, lower/regenerative without offset

All of the following limits act on the torque setpoint – that is either available at the speed controller output for closed-loop speed control or as torque input, for closed-loop torque control. The minimum or the maximum is used for the various limits. This minimum or maximum is cyclically calculated and is displayed in r1538 or r1539.

- r1538 Upper effective torque limit
- r1539 Lower effective torque limit

These cyclical values therefore limit the torque setpoint at the speed controller output/torque input or indicate the instantaneous max. possible torque. If the torque setpoint is limited, then this is displayed using parameter p1407.

- r1407.8 Upper torque limit active
- r1407.9 Lower torque limit active

Function diagram

FP 6060, 6630, 6640

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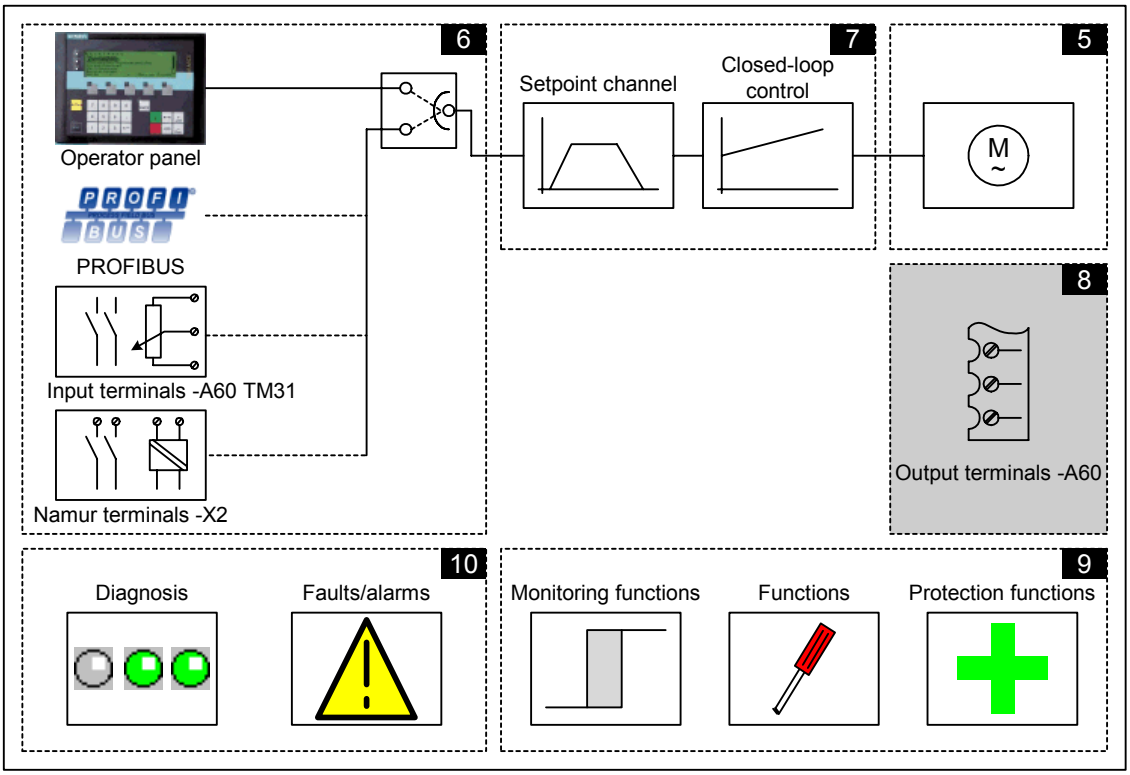
Output Terminals

8

8.1 Chapter Content

This chapter provides information on:

- Analog outputs
- Digital outputs



Function Diagrams

To supplement this operating manual, the documentation folder contains simplified function diagrams describing the operating principle of the SINAMICS G150. The diagrams are arranged in accordance with the chapters in the operating manual. The page numbers (8xx) describe the functionality in the following chapter. At certain points in this chapter, reference is made to function diagrams with a 4-digit number. These are stored on the documentation CD in the "SINAMICS G List Manual", which provides experienced users with detailed descriptions of all the functions.

8.2 Analog Outputs

Description

The customer terminal block features two analog outputs for outputting setpoints via current or voltage signals.

Factory setting:

- AO0: Actual speed value: 0 – 20 mA
- AO1: Actual motor current: 0 – 20 mA

Signal Flow Diagram

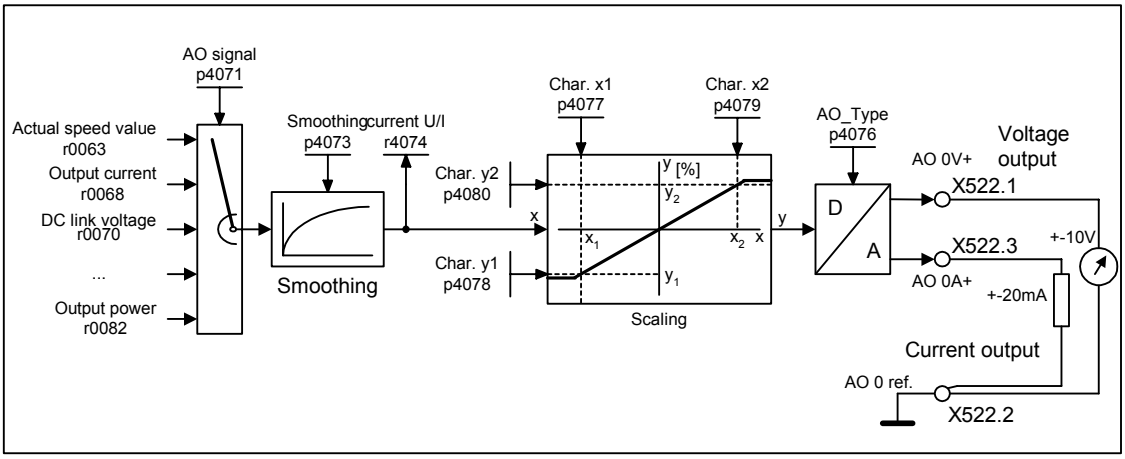


Fig. 8-1 Signal flow diagram: Analog output 0

Function Diagram

FD 1840, 9572

Parameters

- p4071 Analog outputs, signal source
- p4073 Analog outputs, smoothing time constant
- r4074 Analog outputs, actual output voltage/current
- p4076 Analog outputs, type
- p4077 Analog outputs, characteristic value x1
- p4078 Analog outputs, characteristic value y1
- p4079 Analog outputs, characteristic value x2
- p4080 Analog outputs, characteristic value y2

List of Signals for the Analog Outputs

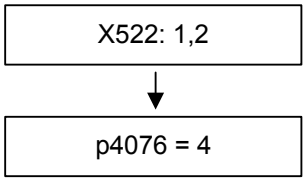
Signal	Parameter	Unit	Scaling (100 % = ...), see Table 8-1
Speed setpoint upstream of setpoint filter	r0060	1/min	p2000
Motor speed unsmoothed	r0061	1/min	p2000
Actual speed after smoothing	r0063	1/min	p2000
Output frequency	r0066	Hz	Reference frequency
Output current	r0068	Aeff	p2002
DC link voltage	r0070	V	p2001
Torque setpoint	r0079	Nm	p2003
Output power	r0082	kW	r2004
For diagnostic purposes			
Speed controller system deviation	r0064	1/min	p2000
Control factor	r0074	%	Reference control factor
Torque-generating current setpoint	r0077	A	p2002
Torque-producing actual current	r0078	A	p2002
Flux setpoint	r0083	%	Reference flux
Actual flux	r0084	%	Reference flux
For further diagnostic purposes			
Speed controller output	r1480	Nm	p2003
I component of speed controller	r1482	Nm	p2003

Scaling

Table 8-1 Scaling

Size	Scaling parameter	Default for quick commissioning
Reference speed	100 % = p2000	p2000 = Maximum speed (p1082)
Reference voltage	100 % = p2001	p2001 = 1000 V
Reference current	100 % = p2002	p2002 = Current limit (p0640)
Reference torque	100 % = p2003	p2003 = 2 x rated motor torque
Reference power	100 % = r2004	$r2004 = \frac{p2003 \times p2000 \times \pi}{30}$
Reference frequency	$100\,\% = \frac{p2000}{60}$	
Reference control factor	100 % = Maximum output voltage without overload	
Reference flux	100 % = Rated motor flux	
Reference temperature	100% = 100 °C	

Example: Changing Analog Output 0 from Current to Voltage Output –10 to +10 V

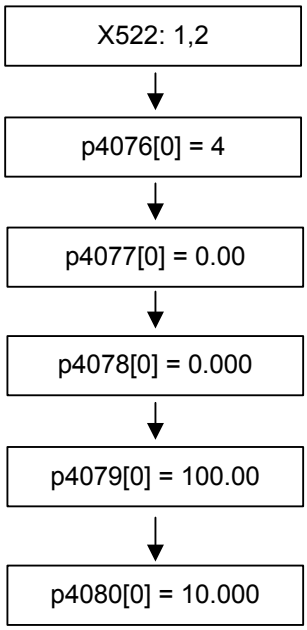


Voltage output present at terminal 1, ground is at terminal 2

Set analog output type 0 to -10 ... +10 V.

Fig: 8-2 Example: Setting analog output 0

Example: Changing Analog Output 0 from Current to Voltage Output –10 - +10 V and Setting the Characteristic



Voltage output present at terminal 1, ground is at terminal 2

Set TM31.AO_type [analog output 0] to -10 ... +10 V.

Set TM31.AO_char. x1 to 0.00 %.

Set TM31.AO_char. y1 to 0.000 V.

Set TM31.AO_char. x2 to 100.00%.

Set TM31.AO_char. y2 to 10.000 V.

Fig: 8-3 Example: Setting analog output 0 and the characteristic

8.3 Digital Outputs

Description

Four bi-directional digital outputs (terminal X541) and two relay outputs (terminal X542) are available. These outputs are, for the most part, freely parameterizable.

Signal Flow Diagram

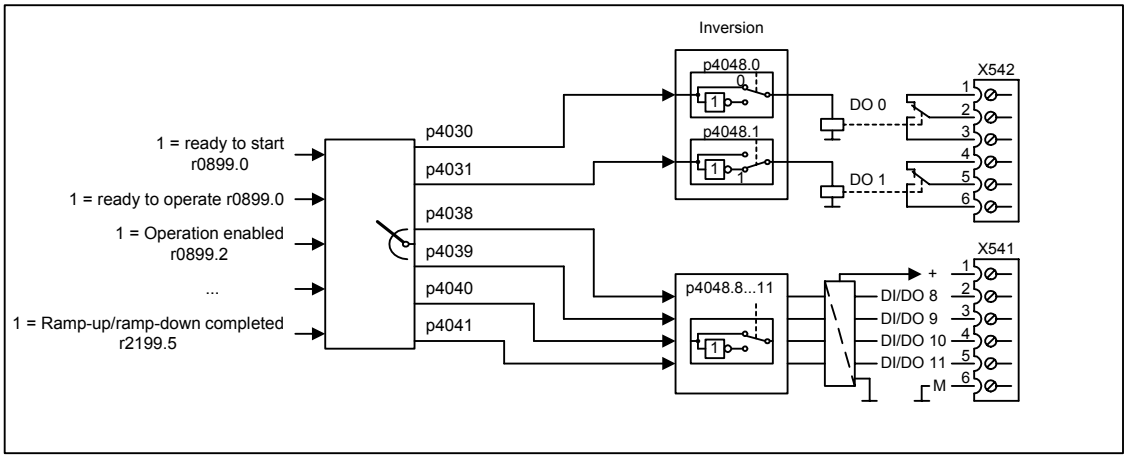


Fig. 8-4 Signal flow diagram: Digital outputs

Factory setting

Digital output	Terminals	Factory setting
DO0	X542: 2,3	"Enable pulses"
DO1	X542: 5,6	"No fault"
DI/DO8	X541: 2	"Ready to power up"
DI/DO9	X541: 3	
DI/DO10	X541: 4	
DI/DO11	X541: 5	

Selection of Possible Connections for the Digital Outputs

Signal	Bit in status word 1	Parameter
1 = Ready to start	0	r0889.0
1 = Ready to operate (DC link loaded, pulses blocked)	1	r0889.1
1 = Operation enabled (drive follows n_setp)	2	r0889.2
1 = Fault present	3	r2139.3
0 = Coast to stop active (OFF2)	4	r0889.4
0 = Fast stop active (OFF3)	5	r0889.5
1 = Power-on disable	6	r0889.6
1 = Alarm present	7	r2139.7
1 = Speed setpoint/actual deviation in the tolerance bandwidth (p2163, p2166)	8	r2197.7
1 = Control required to PLC	9	r0899.9
1 = f or n comparison value reached or exceeded (p2141, p2142)	10	r2199.1
1 = I, M, or P limit reached (p0640, p1520, p1521)	11	r1407.7
Reserved	12	
0 = Alarm motor overtemperature (A7910)	13	r2129.14
Reserved	14	
0 = Alarm thermal overload in power section (A5000)	15	r2129.15
1 = Pulses enabled (inverter is clocking, drive is carrying current)		r0899.11
1 = n_act ≤ p2155		r2197.1
1 = n_act > p2155		r2197.2
1 = Ramp-up/ramp-down completed		r2199.5
1 = n_act < p2161 (preferably as n_min or n=0 message)		r2199.0
1 = Torque setpoint < p2174		r2198.10
1 = LOCAL mode active (control via operator panel)		r0807.0
0 = Motor blocked		r2198.6

■

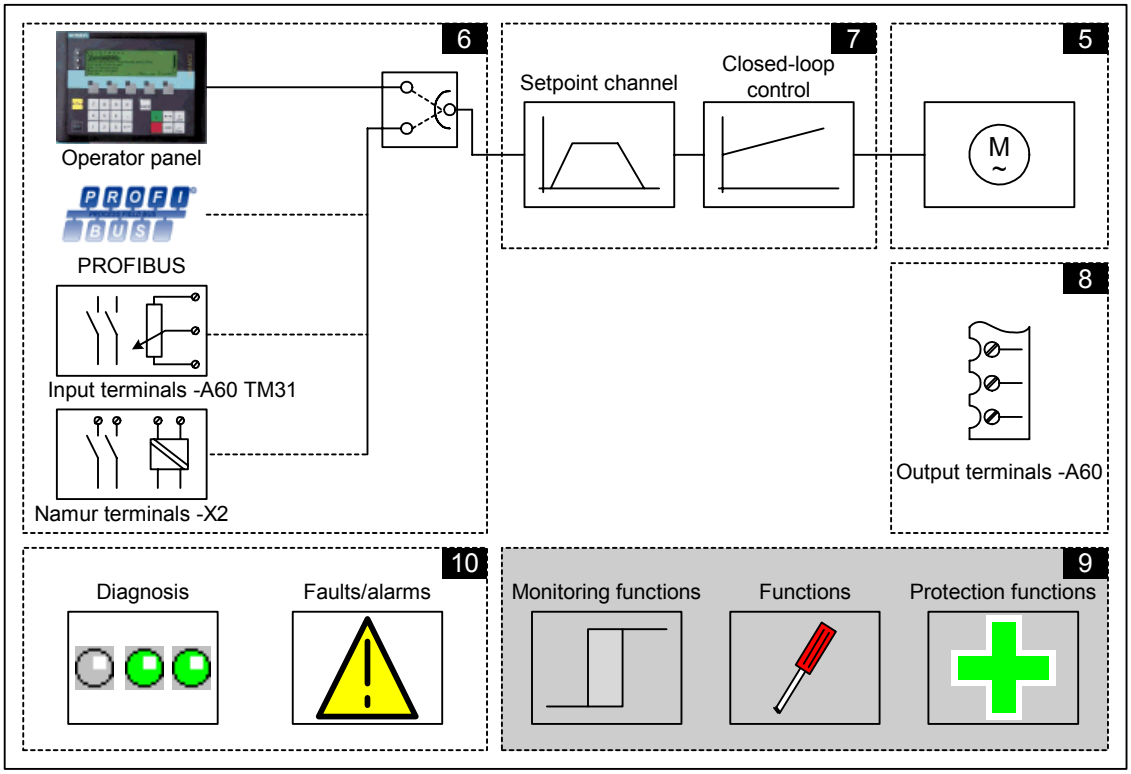
Functions, Monitoring, and Protective Functions

9

9.1 Chapter Content

This chapter provides information on:

- Drive functions:
  Motor identification routine, Vdc control, automatic restart, flying restart, motor changeover, friction characteristic, increase in the output frequency, runtime, simulation operation.
- Extended functions:
  Technology controller, Extended braking control, Extended monitoring functions
- Monitoring and protective functions:
  Power Module protection, thermal monitoring functions and overload responses, anti-stall protection, stall protection, thermal motor protection.



Function Diagrams

To supplement this operating manual, the documentation folder contains simplified function diagrams describing the operating principle of the SINAMICS G150. The diagrams are arranged in accordance with the chapters in the operating manual. The page numbers (9xx) describe the functionality in the following chapter.

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9.2 Drive Functions

9.2.1 Motor Identification and Automatic Speed Controller Optimization

Description

Two motor identification options, which are based on each other, are available:

- Standstill measurement with p1910 (motor identification)
- Rotating measurement with p1960 (speed controller optimization)

These can be selected more easily via p1900. p1900 = 2 selects the standstill measurement (motor not rotating). p1900 = 1 also activates the rotating measurement; p1900 = 1 sets p1910 = 1 and p1960 in accordance with the current control type (p1300).

Parameter p1960 is set depending on p1300:

- p1960 = 1, when p1300 = 20 or 22
- p1960 = 2, when p1300 = 21 or 23

Motor identification is not started until all the enable signals are set and the next switch-on command is issued. This is indicated using appropriate alarms (A07991 for the standstill measurement and A07980 for the rotating measurement).

When the standstill measurement is complete, the drive switches itself off automatically and p1910 is automatically reset to 0. To start the rotating measurement, the drive has to be switched on again. The drive also switches itself off automatically when this measurement is complete and p1960 (and p1900) is reset to 0. The ON command must be canceled.

The measurements can be aborted by canceling the enable signals (e.g. OFF) or by resetting the parameters.

NOTE

To set the new controller setting permanently, the data must be saved with p0977 or p0971 on the non-volatile CompactFlash card.

9.2.1.1 Standstill Measurement

Description

Motor identification with p1910 is used for determining the motor parameters at standstill (see also p1960: speed controller optimization):

- Equivalent circuit diagram data p1910 = 1

For control engineering reasons, you are strongly advised to carry out motor identification because the equivalent circuit diagram data, motor cable resistance, IGBT on-state voltage, and compensation for the IGBT lockout time can only be estimated if the data on the type plate is used. For this reason, the stator resistance for the stability of sensorless vector control or for the voltage boost with the V/f characteristic is very important.

Motor identification is essential if long supply cables or third-party motors are used. When motor data identification is started for the first time, the following data is determined with p1910 = 1 on the basis of the data on the type plate (rated data):

- Equivalent circuit diagram data
- Total resistance of:
  - Power cable resistor (R_{cable})
  - Stator resistance (R_S)
- IGBT on-state voltage and compensation for the IGBT lockout times

Since the type plate data contains the initialization values for identification, you must ensure that it is entered correctly and consistently to enable the above data to be determined.

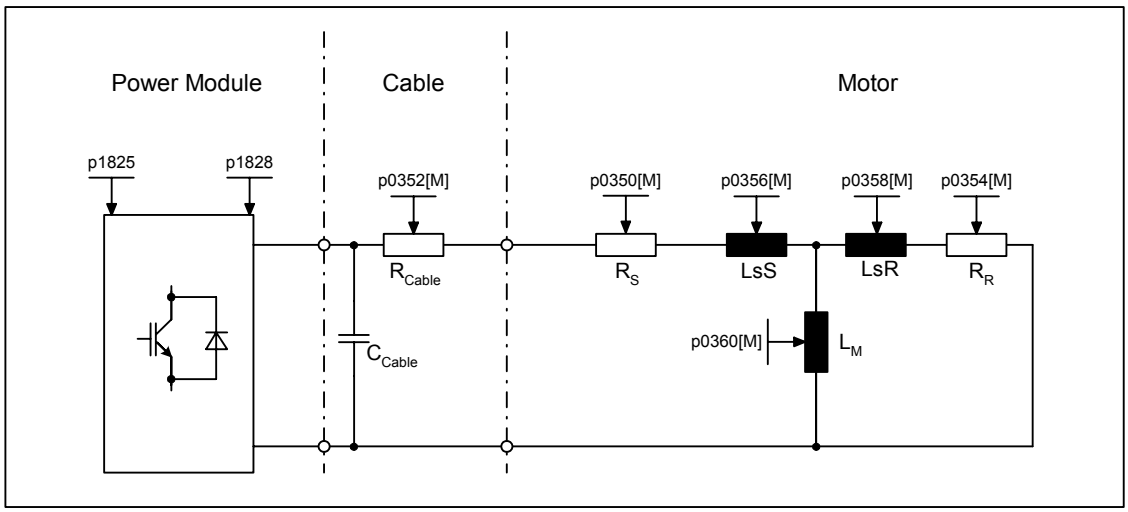


Fig. 9-1 Equivalent circuit diagram for induction motor and cable

Carrying out Motor Identification

- Enter p1910 = 1. Alarm A07991 is displayed.
- Identification starts when the motor is switched on.
- p1910 resets itself to "0" (successful identification) or fault F07990 is output.

NOTE

To set the new controller setting permanently, the data must be saved with p0977 or p0971 on the non-volatile CompactFlash card.

WARNING

During motor identification, the drive may cause the motor to move.

The emergency OFF functions must be fully operational during commissioning. To protect the machines and personnel, the relevant safety regulations must be observed.

The following parameters are determined by means of motor identification:

- p1910 = 1: p0350, p0354, p0356, p0358, p0360, p1825, p1828, p1829, p1830

9.2.1.2 Rotating Measurement and Speed Controller Optimization

Description

Speed controller optimization determines the data required (e.g. moment of inertia) for setting the speed controller. It also measures the magnetization characteristic and rated magnetization current of the motor.

Speed control can be optimized via p1960 or p1900 = 1.

If the rotating measurement is not to be carried out using the speed set in p1965, this parameter can be changed before the measurement is started.

The speed controller is set to the symmetrical optimum in accordance with dynamic factor p1967.

If any problems occur during the measurement, the dynamic response is reduced automatically and the result displayed in r1969. The drive must also be checked to ensure that it is stable across the entire range. If necessary, the dynamic response may have to be reduced or Kp/Tn adaptation for the speed controller parameterized accordingly (see FP 6050).

If the motor–Power Module combination is operated in the field-weakening range, this characteristic should be determined for vector control in particular. The magnetization characteristic can be used to calculate the field-generating current in the field-weakening range more accurately, thereby increasing torque accuracy.

NOTE

Speed controller optimization (p1960) allows the rated magnetization current and magnetization characteristic to be determined more accurately.

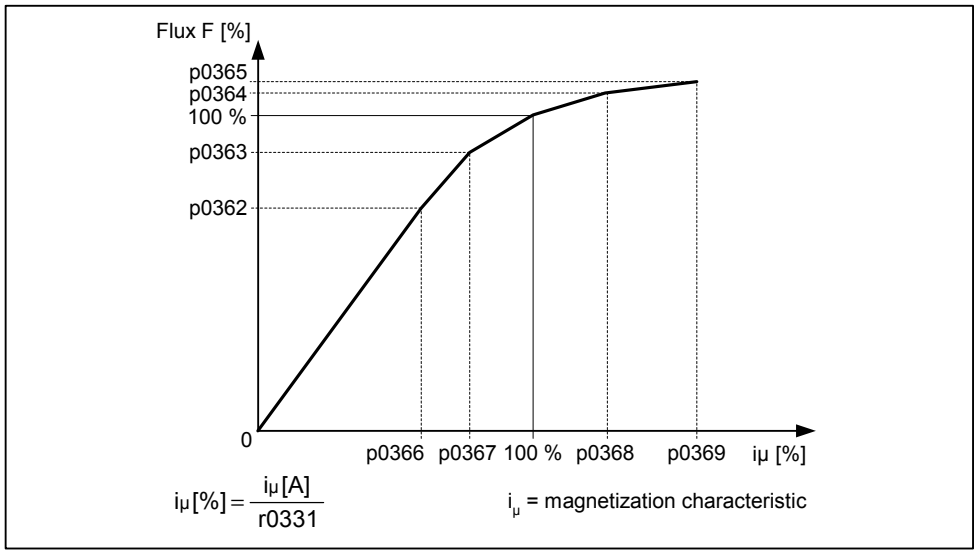


Fig. 9-2 Magnetization characteristic

Carrying out Rotating Measurement

The following measurements are carried out when the enable signals are set and a switch-on command is issued.

- Measurement of the magnetization characteristic (p0362 to p0369)
- Measurement of the magnetization current (p0320)
- Speed controller optimization
  - p1470 and p1472
  - Kp adaptation switch-off
- Acceleration pre-control setting (p1496)
- Setting for ratio between the total moment of inertia and that of the motor (p0342)

NOTE

To set the new controller setting permanently, the data must be saved with p0977 or p0971 on the non-volatile CompactFlash card.

DANGER

During speed controller optimization, the drive triggers movements in the motor that can reach the maximum motor speed. The emergency OFF functions must be fully operational during commissioning. To protect the machines and personnel, the relevant safety regulations must be observed.

Parameters

- p1959 Speed controller optimization configuration
- p1960 Speed controller optimization selection
- p1961 Saturation characteristic speed for calculation
- p1965 Speed controller optimization speed
- p1967 Speed controller optimization dynamic factor
- r1969 Speed controller, identified optimization inertia

9.2.2 Vdc Control

Description

The “Vdc control” function can be activated using the appropriate measures if an overvoltage or undervoltage is present in the DC link.

- Overvoltage in the DC link
  - Typical cause:
    The drive is operating in regenerative mode and is supplying too much energy to the DC link.
  - Remedy:
    Reduce the regenerative torque to maintain the DC link voltage within permissible limits.
- Undervoltage in the DC link
  - Typical cause:
    Failure of the supply voltage or supply for the DC link.
  - Remedy:
    Specify a regenerative torque for the rotating drive to compensate the existing losses, thereby stabilizing the voltage in the DC link (kinetic buffering).
    Kinetic buffering is only possible as long as energy is generated by the movement of the drive.

Properties

- Vdc control
  - This comprises Vdc_max control and Vdc_min control (kinetic buffering), which are independent of each other.
  - It contains a joint PI controller. The dynamic factor is used to set Vdc_min and Vdc_max control to a smoother or harder setting independently of each other.
- Vdc_min control (kinetic buffering)
  - With this function, the kinetic energy of the motor is used for buffering the DC link voltage in the event of a momentary power failure, thereby delaying the drive.
- Vdc_max Closed-Loop Control
  - This function can be used to control a momentary regenerative load without shutdown with “overvoltage in DC link“.
  - Vdc_max control is only recommended with a supply without active closed-loop control for the DC link and without feedback.

Description of Vdc_min Control (Kinetic Buffering)

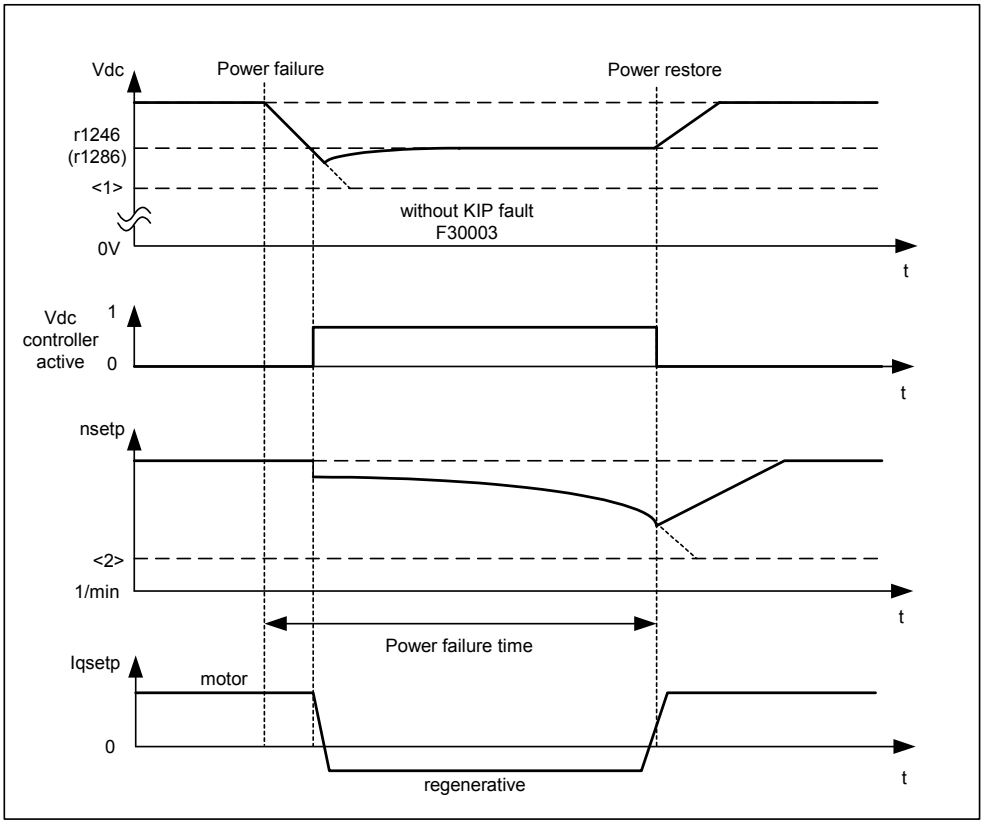


Fig. 9-3 Switching Vdc_min control on/off (kinetic buffering)

NOTE

Kinetic buffering must only be activated in conjunction with an external power supply.

When Vdc_min control is enabled with p1240 = 2,3 (p1280)[1] it is activated in the event of a power failure when the Vdc_min switch-in level (r1246 (r1286)) is undershot. In general, the regenerative power (braking energy) of the drive machine generated when the motor speed is reduced is used to support the DC link voltage of the converter; in other words, when Vdc_min control is active, the motor speed no longer follows the main setpoint and can be reduced to a standstill. The SINAMICS continues operating until the shutdown threshold of the DC link voltage (see Fig. 9-3 <1>) is undershot.

[1] All data in brackets apply for V/f open-loop control

- V/f control

  The Vdc_min controller acts on the speed setpoint path. When Vdc_min control is active, the drive setpoint speed is reduced so that the drive becomes regenerative.
- Speed control

  The Vdc_min controller acts on the speed controller output and affects the torque-generating current setpoint. When Vdc_min control is active, the torque-generating current setpoint is reduced so that the drive becomes regenerative.

In the event of a power failure, the DC link voltage decreases due to the lack of power from the supply system. When the DC link voltage threshold set via parameter p1245 (p1285) is reached, the Vdc_min controller is activated. Due to the PID properties of the controller, the motor speed is reduced to the extent that the regenerative drive energy maintains the DC link voltage at the level set in p1245 (p1285). The kinetic energy of the drive governs the dropout characteristic of the motor speed and, in turn, the buffering duration. In centrifugal mass drives (e.g. fans), buffering can last a few seconds. In drives with a low centrifugal mass (e.g. pumps), however, buffering can last just 100 – 200 ms. When the power is restored, the Vdc_min controller is deactivated and the drive is ramped up to its setpoint speed at the ramp-function generator ramp. Alarm A7402 (drive: DC link voltage minimum controller active) is present as long as the Vdc_min controller is active.

If the drive can no longer generate any regenerative energy because, for example, it is almost at a standstill, the DC link voltage continues to drop. If the minimum DC link voltage is undershot (see Fig. 9-3 <1>), the drive is switched off with fault F30003 (power section: DC link undervoltage).

If a speed threshold (see Fig. 9-3 <2>) set with parameter p1257 (p1297) is undershot when Vdc_min control is active, the drive is switched off with F7405 (drive: kinetic buffering minimum speed undershot).

If a shutdown with undervoltage in the DC link (F30003) occurs without the drive coming to a standstill despite the fact that Vdc_min control is active, the controller may have to be optimized via dynamic factor p1247 (p1287). Increasing the dynamic factor in p1247 (p1287) causes the controller to intervene more quickly. The default setting for this parameter, however, should be suitable for most applications.

Parameter P1256 = 1 (p1296) can be used to activate time monitoring for kinetic buffering. The monitoring time can be set in parameter p1255 (p1295). If buffering (i.e. the power failure) lasts longer than the time set here, the drive is switched off with fault F7406 (drive: maximum duration for kinetic buffering exceeded). The standard fault reaction for this fault is OFF3, which means that this function can be used for controlled drive deceleration in the event of a power failure. In this case, excess regenerative energy can only be dissipated via an additional braking resistor.

Description of Vdc_max Control

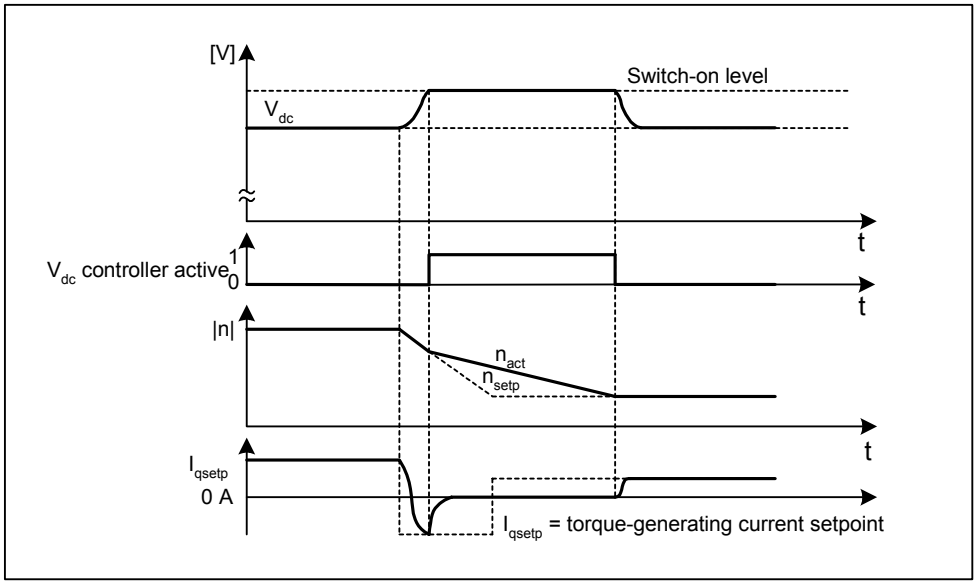


Fig. 9-4 Switching Vdc_max control on/off

The switch-on level of the Vdc_max control (r1242 or r1282) is calculated as follows:

- when the automatic switch-in level sensing is disabled (p1254 = 0)
  r1242 (r1282) = 1.15 x p0210 (unit supply voltage, DC link)
- when the automatic switch-on level sensing is enabled (p1254 = 1)
  r1242 (r128) = Vdc_max - 50 V (Vdc_max: overvoltage threshold of the Power Module)

Function Diagram

FP6220 (FP6320)

Parameters

- p1240 (p1280) Vdc controller configuration
- r1242 (r1282) Vdc_min controller switch-in level
- p1243 (p1283) Vdc_max controller dynamic factor
- p1245 (p1285) Vdc_min controller switch-in level
- p1246 (p1286) Vdc_min controller switch-in level
- p1247 (p1287) Vdc_min controller dynamic factor
- p1250 (p1290) Vdc controller proportional gain
- p1251 (p1291) Vdc controller integral action time
- p1252 (p1292) Vdc controller derivative-action time

- (p1293) Vdc_min controller output limit (V/f control)
- p1254 (p1294) Vdc_max controller automatic ON level detection
- p1255 (p1295) Vdc_min controller time threshold
- p1256 (p1296) Vdc_min controller response
- p1257 (p1297) Vdc_min controller speed threshold
- r1258 (r1298) Vdc controller output

9.2.3 Automatic Restart

Description

The automatic restart function automatically restarts the cabinet unit after an undervoltage or a power failure. The alarms present are acknowledged and the drive is restarted automatically.

The drive can be restarted using

- The normal procedure for starting the drive from standstill
- The flying restart function. For drives with small inertia loads and load torques where the drive can be brought to a standstill within seconds (such as pump drives with water gauges), the start from standstill is recommended.

NOTE

The flying restart function can also be activated for drives with large inertia loads (such as fan drives). This enables you to switch to the motor that is still rotating.

WARNING

If p1210 is set to >1, the motor can be restarted automatically without the need to issue the ON command.

In the event of prolonged power failures and when the automatic restart function is activated (p1210 > 1), the drive may have been at a standstill for a long time and mistakenly considered to have been switched off.

For this reason, entering the area around the drive when it is in this condition can cause death, serious injury, or considerable material damage.

Parameters

- p1210 Automatic restart, mode
- p1211 Automatic restart, start attempts
- p1212 Automatic restart, delay time start attempts
- p1213 Wiedereinschaltautomatik Überwachung Netzwiederkehr

Settings

To prevent the motor from switching to phase opposition when the drive is being restarted, there is a delay while the motor demagnetizes (t = 2.3 x motor magnetization time constant). Once this time has elapsed, the inverter is enabled and the motor is supplied with power.

9.2.4 Flying Restart

Description

The "Flying restart" function (enabled via p1200) allows the converter to switch to a motor that is still rotating. Switching on the converter without the flying restart function would not allow any flux to build up in the motor while it is rotating. Since the motor cannot generate any torque without flux, this can cause it to switch off due to overcurrent (F07801).

The flying restart function first determines the speed of the drive with which V/f or vector control is initialized so that the converter and motor frequency can be synchronized.

During the standard start-up procedure for the converter, the motor must be at a standstill. The converter then accelerates the motor to the setpoint speed. In many cases, however, the motor is not at a standstill.

Two different situations are possible here:

a.) The drive rotates as a result of external influences, such as water (pump drives) or air (fan drives). In this case, the drive can also rotate against the direction of rotation.

b.) The drive rotates as a result of a previous shutdown (e.g. OFF 2 or a power failure). The drive slowly coasts to a standstill as a result of the kinetic energy stored in the drive train (example: induced-draft fan with a high inertia load and a steeply descending load characteristic in the lower speed range).

Depending on the setting chosen (p1200), the flying restart function is activated in the following situations:

- Once power has been restored and the automatic restart function is active.
- After a shutdown with the OFF2 command (pulse inhibit) when the automatic restart function is active.
- When the ON command is issued.

NOTE

The flying restart function must be used when the motor may still be running or is being driven by the load to prevent shutdowns due to overcurrent (F7801).

NOTE

- If the value set for parameter p1203 (search speed factor) is higher, the search curve is flatter and, as a result, the search time is longer. A lower value has the opposite effect.
- In motors with a low moment of inertia, the flying restart function can cause the drive to accelerate slightly.
- In group drives, the flying restart function should not be activated due to the different coasting properties of the individual motors.

9.2.4.1 Flying Restart Without Encoder

Depending on parameter p1200, the flying restart function is started with the maximum search speed ($n_{search,max}$) once the de-excitation time (p0347) has elapsed (see Fig. 9-5).

$$n_{search,max} = 1.25 \cdot n_{max}(p1082)$$

The flying restart function behaves differently with V/f control and vector control:

- V/f characteristic (p1300 < 20):
  The search speed yielded from parameter p1203 reduces the search frequency in accordance with the motor current. The parameterizable search current (p1202) is injected here. If the search frequency is similar to the rotor frequency, a current minimum occurs. Once the frequency has been found, the motor is magnetized. The output voltage during the magnetization time (p0346) is increased to the voltage value yielded from the V/f characteristic (see Fig. 9-5).
- Vector control without encoder:
  The motor speed is determined using the speed adaptation control loop for the electric motor model. To begin with, the search current (p1202) is injected and then the controller is activated starting from the maximum search frequency. The dynamic response of the controller can be altered using the search speed factor (p1203). If the deviation of the speed adaptation controller is not too great, the motor continues to be magnetized for the duration parameterized in p0346.

Once the excitation build-up time (p0346) has elapsed, the ramp-function generator is set to the actual speed value and the motor ramped up to the current setpoint frequency.

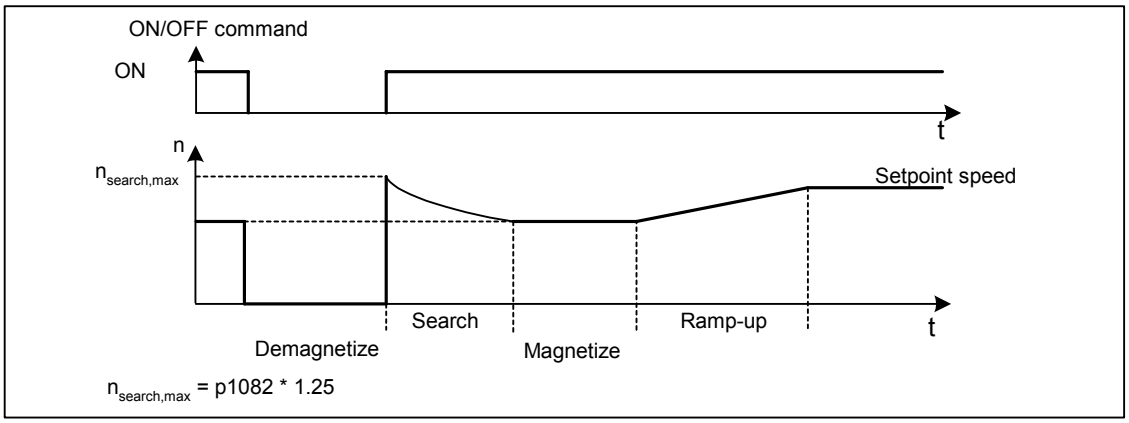


Fig. 9-5 Flying restart

WARNING

When the “Flying restart” (p1200) function is active, the drive may still be accelerated by the detection current despite the fact that it is at standstill and the setpoint is 0!

For this reason, entering the area around the drive when it is in this condition can cause death, serious injury, or considerable material damage.

9.2.4.2 Flying Restart with Encoder

The flying restart function behaves differently with V/f control and vector control:

- V/f characteristic (p1300 < 20):
  Refer to Section 9.2.4.1 (Flying Restart Without Encoder).
- Vector control with encoder:
  Since the speed is known from the start, the motor can be magnetized immediately at the appropriate frequency. The duration of magnetization is specified in p0346. Once the excitation build-up time has elapsed, the ramp-function generator is set to the actual speed value and the motor ramped up to the current setpoint speed.

WARNING

When the flying restart (p1200) function is active, the drive may still be accelerated by the detection current despite the fact that it is at standstill and the setpoint is 0.

For this reason, entering the area around the drive when it is in this condition can cause death, serious injury, or considerable material damage.

9.2.4.3 Parameters

- p1200 FlyRest oper mode
  - 0: FlyRestart inactive
  - 1: Flying restart is always active (start in the setpoint direction).
  - 2: Flying restart is active after: power-on, fault, OFF2 (start in the setpoint direction).
  - 3: Flying restart is active after: fault, OFF2. (start in the setpoint direction).
  - 4: Flying restart is always active (start only in the setpoint direction).
  - 5: Flying restart is active after: power-on, fault, OFF2 (start only in the setpoint direction).
  - 6: Flying restart is active after: fault, OFF2 (start only in the setpoint direction).
- p1202 FlyRest srch curr
- p1203 Flying restart search rate factor
- r1204 Flying restart, V/F control status
- r1205 Flying restart, vector control status

9.2.5 Motor changeover

9.2.5.1 Description

The motor data set changeover is, for example, used for:

- Changing over between different motors
- Changing-over between different windings in a motor (e.g. star-delta changeover)
- Motor data adaptation

9.2.5.2 Example of changing over between two motors

Requirements

- The drive has been commissioned for the first time.
- 2 motor data sets (MDS), p0130 = 2
- 2 drive data sets (DDS), p0180 = 2
- 2 digital outputs to control the auxiliary contactors
- 2 digital inputs to monitor the auxiliary contactors
- 1 digital input to select the data set
- 2 auxiliary contactors with auxiliary switches (1 NO contact)
- 2 motor contactors with positively-driven auxiliary switches (1 NC contact, 1NO contact)

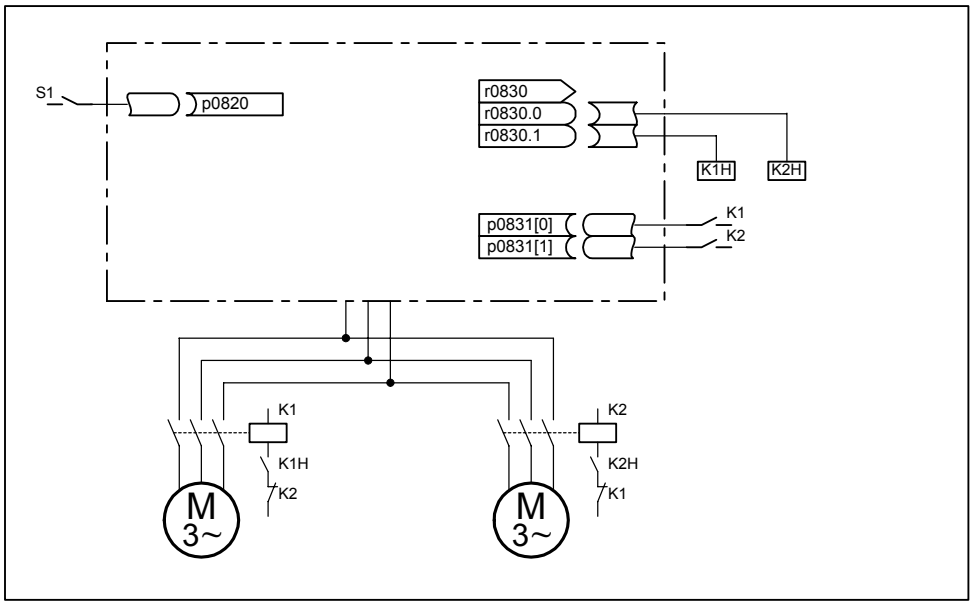


Fig. 9-6 Example, motor changeover

Table 9-1 Settings for the motor changeover example

Parameter	Settings	Comment
p0130	2	Configure 2 MDS
p0180	2	Configure 2 DDS
p0186[0..1]	0, 1	The MDS are assigned the DDS.
p0820	Digital input, DDS selection	The digital input to change over the motor is selected via DDS selection. Binary coding is used (p0820 = bit 0 etc.).
p0821 to p0824	0	
p0827[0..1]	0, 1	The bits from p0830 are assigned to the MDS. If e.g. p0827[0] = 0, then when selecting MDS0, bit p0830.0 is set via DDS0.
p0830.0 and p0830.1	Digital outputs, auxiliary contactors	The digital outputs for the auxiliary contactors are assigned bits.
p0831[0..1]	Digital inputs, auxiliary switches	The digital inputs for the feedback signal of the motor contactors are assigned.
p0833[0..1]	0, 0	The drive controls the contactors and the pulse cancellation.

Motor changeover sequence

1. Pulse cancellation:
   The pulses are cancelled after selecting a new drive data set using p0820 to p0824.
2. Open the motor contactor:
   Motor contactor 1 is opened r0830 = 0 and the status bit "Motor changeover active" (r0835.0) is set.
3. Change over the drive data set:
   The requested data set is activated (p0051 = requested data set).
4. Energize the motor contactor:
   After the feedback signal (motor contactor opened) for motor contactor 1, the appropriate bit of r0830 is set and motor contactor 2 is energized.
5. Enable the pulses:
   After the feedback signal (motor contactor closed) for motor contactor 2, the bit "motor data set changeover active" (r0835.0) is reset and the pulses are enabled. The motor has been changed over.

9.2.5.3 Example of a star / delta changeover

Motors with star/delta changeover allow a wide constant power range to be achieved. At lower speeds, the motor is operated in the star circuit configuration (high torque) and at higher speeds, in the delta circuit configuration (high stall torque). Changeover is also possible during operation.

Requirements

- The drive has been commissioned for the first time.
- 2 motor data sets (MDS), p0130 = 2
- 2 drive data sets (DDS), p0180 = 2
- 2 digital outputs to control the auxiliary contactors
- 2 digital inputs to monitor the auxiliary contactors
- 1 free speed monitoring (p2155)
- 2 auxiliary contactors with auxiliary switches (1 NO contact)
- 2 motor contactors with positively-driven auxiliary switches (1 NC contact, 1NO contact)

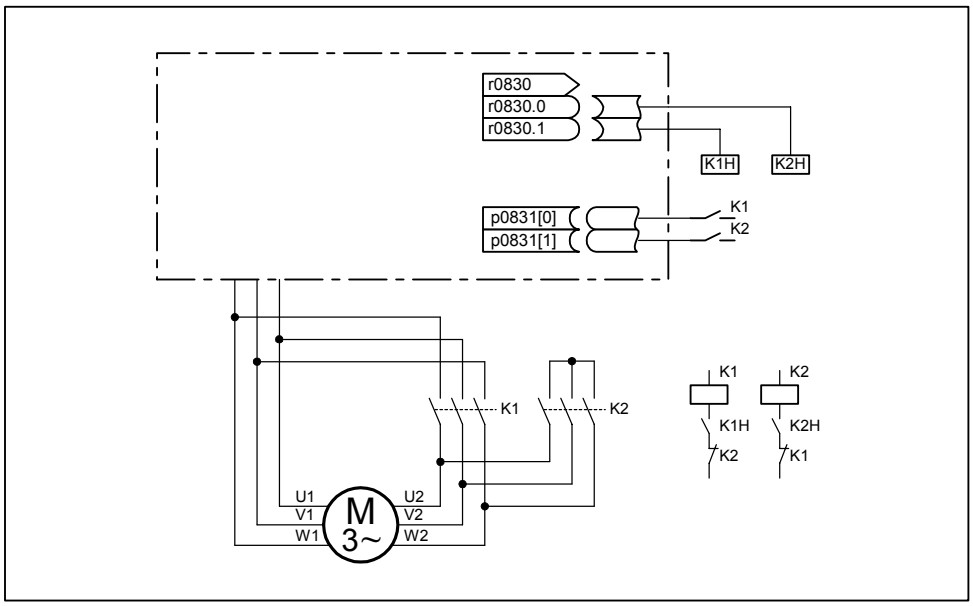


Fig. 9-7 Example, star/delta changeover

Table 9-2 Settings for the examples star/delta changeover

Parameter	Settings	Comment
p0130	2	Configure 2 MDS
p0180	2	Configure 2 DDS
p0186[0..3]	0, 1	The MDS are assigned the DDS.
p0820	p2197.2	Change over to the delta circuit configuration after the speed in p2155 has been exceeded.
p0821 to p0824	0	
p0827[0..1]	0, 1	The bits from p0830 are assigned to the MDS. If e.g. p0827[0] = 0, then when selecting MDS0, bit p0830.0 is set via DDS0.
p0830.0 and p0830.1	Digital outputs, auxiliary contactors	The digital outputs for the auxiliary contactors are assigned bits.
p0831[0..1]	Digital inputs, auxiliary switches	The digital inputs for the feedback signal of the motor contactors are assigned.
p0833[0..1]	0, 0	The drive controls the contactors and the pulse cancellation.
p2155	Changeover speed	Sets the speed where the delta circuit configuration should be selected.

Star / delta changeover sequence

1. Pulse cancellation:
   After selecting a new drive data set using p0820, the pulses are cancelled.
2. Open the motor contactor:
   Motor contactor 1 is opened r0830 = 0 and the status bit "Motor changeover active" (r0835.0) is set.
3. Change over the drive data set:
   The requested data set is activated (p0051 = requested data set).
4. Energize the motor contactor:
   After the feedback signal (motor contactor opened) for motor contactor 1, the appropriate bit of r0830 is set and motor contactor 2 is energized.
5. Enable the pulses:
   After the feedback signal (motor contactor closed) for motor contactor 2, the bit "motor data set changeover active" (r0835.0) is reset and the pulses are enabled. The changeover has been completed.

9.2.5.4 Function diagram

- 8565 Drive data set (DDS)
- 8575 Motor data sets (MDS)

9.2.5.5 Parameters

- r0051 Drive data set DDS effective
- p0130 Motor data sets (MDS) number
- p0180 Drive data set (DDS) number
- p0186 Motor data sets (MDS) number
- p0819[0...2] Copy drive data set DDS
- p0820 BI: Drive data set selection, bit 0
- p0821 BI: Drive data set selection, bit 1
- p0822 BI: Drive data set selection, bit 2
- p0823 BI: Drive data set selection, bit 3
- p0824 BI: Drive data set selection, bit 4
- p0826 Motor changeover, motor number
- p0827 Motor changeover, status bit number
- p0828 Motor changeover, feedback signal
- p0830 Motor changeover, status
- p0831 Motor changeover, contactor feedback signal
- p0833 Motor changeover, configuration

9.2.6 Friction characteristic

Description

The friction characteristic is used to compensate for the frictional torque of the motor and driven load. A friction characteristic allows the speed controller to be pre-controlled and improves the control behavior.

10 points along the characteristic are used for the friction characteristic. The coordinates of every point along the characteristic are defined by a speed parameter (p382x) and a torque parameter (p383x) (point 1 = p3820 and p3830).

Features

- There are 10 points along the characteristic to represent the friction characteristic.
- An automatic function supports the friction characteristic plot.
- A connector output (r3841) can be interconnected as friction torque (p1569).
- The friction characteristic can be activated and de-activated (p3842)

Commissioning

Speeds for making measurements as a function of the maximum speed p1082 are pre-assigned in p382x when commissioning the drive system for the first time. These can be appropriately changed corresponding to the actual requirements.

The automatic friction characteristic plot can be activated using p3845. The characteristic is then plotted the next time that it is enabled.

The following settings are possible:

- p3845 = 0 Friction characteristic plot de-activated
- p3845 = 1 Friction characteristic plot activated, all directions of rotation
  The friction characteristic is plotted in both directions of rotation. The result of the positive and negative measurement is averaged and entered into p383x.
- p3845 = 2 Friction characteristic plot activated, positive direction of rotation
- p3845 = 3 Friction characteristic plot activated, negative direction of rotation

DANGER

When plotting the friction characteristic, the drive causes the motor to move – the maximum motor speed can be reached.

When commissioning the drive, the EMERGENCY STOP functions must function perfectly. To protect the machines and personnel, the relevant safety regulations must be carefully observed.

Function diagram

FP 7010

Parameters

- p3820 Friction characteristic, value n0
- ...
- p3839 Friction characteristic, value M9
- r3840 Friction characteristic, status
- r3841 Friction characteristic, output
- p3842 Activate friction characteristic
- p3845 Activate friction characteristic plot

9.2.7 Increasing the Output Frequency

Description

In applications that require higher output frequencies, the pulse frequency of the power module may have to be increased.

Since increasing the pulse frequency also increases the switching losses, a derating factor for the output current must be taken into account when the drive is configured.

Once the pulse frequency has been increased, the new output currents are automatically included in the calculation for power section protection.

Default Pulse Frequencies

With the default pulse frequencies listed below, the following maximum output frequencies can be achieved.

Table 9-3 Maximum output frequency with default pulse frequency

Converter rating [kW]	Default pulse frequency [kHz]	Maximum output frequency [Hz]
Supply voltage 380 – 480 V		
110 – 250	2	160
315 – 900	1.25	100
Supply voltage 500 – 600 V		
110 – 1000	1.25	100
Supply voltage 660 – 690 V		
75 – 1500	1.25	100

Maximum Output Frequencies Achieved by Increasing the Pulse Frequency

By multiplying the basis pulse frequency (with integers), the following output frequencies can be achieved (taking into account the derating factors):

Table 9-4 Maximum output frequencies achieved by increasing the pulse frequency

Pulse frequency [kHz]	Maximum output frequency [Hz]
1,25	100
2	160
2,5	200
4	320 [1)]
5	400 [1)]

Parameter

- p1800 Pulse frequency

[1)] Due to the closed-loop control, the maximum output frequency is limited to 300 Hz.

9.2.8 Runtime (Operating Hours Counter)

Total System Runtime

The total system runtime is displayed in p2114. Index 0 indicates the system runtime in milliseconds after reaching 86.400.000 ms (24 hours), the value is reset. Index 1 indicates the system runtime in days.

The value is saved when the system is switched off.
After the drive unit is powered-up, the counter continues to run with the value that was saved the last time that the drive unit was powered-down.

Relative System Runtime

The relative system runtime after the last POWER ON is displayed in p0969. The value is in milliseconds nach 49 Tagen läuft der Zähler über.

Actual Motor Runtime

The motor runtime is displayed in p0650 in hours. The counter is started when the pulses are enabled. When the pulse enable is withdrawn, the counter is stopped and the value saved.

The values can only be stored with a CU320 with order number 6SL3040-....-0AA1 and version C or higher.

The counter is deactivated with p0651 = 0.

If the maintenance interval set in p0651 is reached, fault F01590 is triggered. Once the motor has been maintained, the maintenance interval must be reset.

Operating Hours Counter for the Fan

The operating hours of the fan in the power section are displayed in p0251.

The number of hours operated can only be reset to 0 in this parameter (e.g. after a fan has been replaced).

The service life of the fan is entered in p0252.

Alarm A30042 is output 500 hours before this figure is reached.

Monitoring is deactivated with p0252 = 0.

9.2.9 Simulation operation

Description

The simulation function is predominantly used to simulate the drive without a motor being connected and without a DC link voltage. In this case, it should be noted that the simulation mode can only be activated under an actual DC link voltage of 40 V. If the voltage lies above this threshold, the simulation mode is reset, and a fault message F07826 is issued.

Communications with a higher-level automation system can be tested using the simulation mode. If the drive is also to return actual values, then it must be ensured that during simulation operation, sensorless operation (V/f) should be selected. This means that large parts of the SINAMICS software – such as software channel, sequence control, communications, technology function, etc. – can be tested in advance without requiring a motor.

Another application is to test the correct functioning of the Power Module. Especially for drive units with higher power ratings 754 kW (690 V) and 110 kW (400 V), after repairs, it is necessary to test the gating of the power semiconductors. This is done by injecting a low DC voltage as DC link voltage (e.g. 12 V). The drive unit is then powered-up and the pulses enabled. It must be possible to run through all of the pulse patterns of the gating unit software.

This means that the software must allow the pulses to be switched-in and various frequencies approached. If a speed encoder is not being used, then this is generally implemented using V/f control or sensorless closed-loop speed control.

NOTE

The following functions are de-activated in the simulation mode:

- Motor data identification
- Motor data identification, rotating without encoder
- Pole position identification

No flying restart is carried-out for V/f control and sensorless closed-loop vector control.

Commissioning

Simulation is activated using p1272 = 1; the following pre-requisites must be fulfilled:

- The drive unit must have been commissioned for the first time (default: Standard induction motors).
- The DC link voltage must lie below 40 V (observe the tolerance of the DC link voltage sensing).

Alarm A07825 (simulation mode activated) must be output during simulation operation.

Parameter

- p1272 Simulation operation

9.3 Extended Functions

9.3.1 Technology Controller

9.3.1.1 Description

The "technology controller" function module allows simple control functions to be implemented, e.g.:

- Liquid level control
- Temperature control
- Dancer position control
- Pressure control
- Flow control
- Simple control without higher-level control
- Tension control

The technology controller is designed as a PID controller, whereby the differentiator can be switched to the control deviation channel or the actual value channel (factory setting). The P, I, and D components can be set separately.

A value of 0 deactivates the corresponding component. Setpoints can be specified via two connector inputs. The setpoints can be scaled via parameters p2255 and p2256.

A ramp-function generator in the setpoint channel can be used to set the setpoint ramp-up/ramp-down time via parameters p2257 and p2258. The setpoint and actual value channel each have a smoothing element. The smoothing time can be set via parameters p2261 and p2265.

The setpoints can be specified via separate fixed setpoints (p2201 to p2215), the motorized potentiometer, or via the field bus (e.g. PROFIBUS).

Pre-control can be integrated via a connector input.

The output can be scaled via parameter p2295 and the control direction reversed. It can be limited via parameters p2291 and p2292 and interconnected as required via a connector output (r2294).

The actual value can be integrated, for example, via an analog input on the TM31.

If a PID controller has to be used for control reasons, the D component is switched to the setpoint/actual value difference (p2263 = 1) unlike in the factory setting. This is always necessary when the D component is to be effective, even if the reference variable changes. The D component can only be activated when p2274 > 0.

9.3.1.2 Commissioning

The "technology controller" function module can be activated by running the commissioning Wizard. Parameter r0108.16 indicates whether the function module has been activated.

Function Diagrams

FD 7950 Technology controller – fixed values

FD 7954 Technology controller – motorized potentiometer

FD 7958 Technology controller – closed-loop control

9.3.1.3 Example: Liquid Level Control

The objective here is to maintain a constant level in the container.

This is carried out by means of a variable-speed pump in conjunction with a sensor for measuring the level.

The level is determined via an analog input (e.g. AI0 TM31) and sent to the technology controller. The level setpoint is defined in a fixed setpoint. The resulting controlled variable is used as the setpoint for the speed controller.

In this example, a terminal module (TM31) is used.

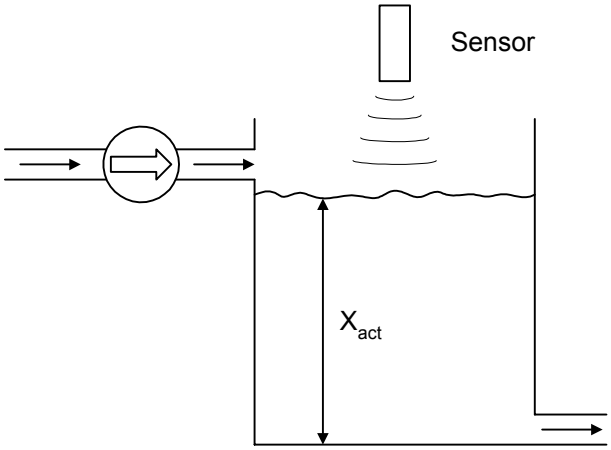


Fig. 9-8 Liquid level control: application

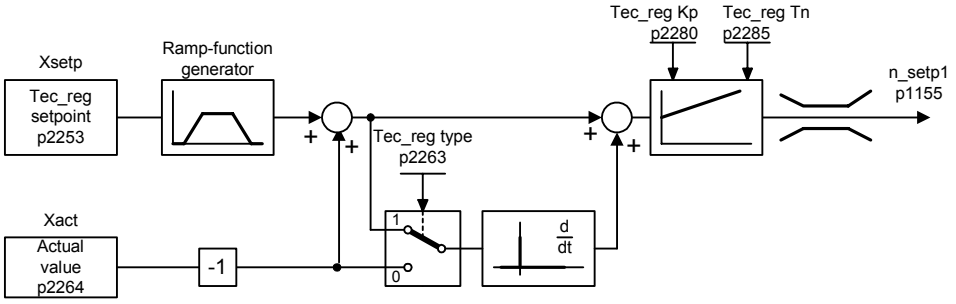


Fig. 9-9 Liquid level control: controller structure

Key control parameters:

- p1155 = r2294 n_setp1 downstream of RFG [FD 3080]
- p2253 = r2224 Technology controller setpoint effective via fixed setpoint [FD 7950]
- p2263 = 1 D component in fault signal [FD 7958]
- p2264 = r4055 Actual value signal X_{actual} via AI0 of TM31 [FD 9566]
- p2280 = Kp Determine by optimization
- p2285 = Tn Determine by optimization
- p2200 = 1 Technology controller enabled

9.3.2 Extended Braking Control

9.3.2.1 Description

The "extended braking control" function module allows complex braking control for motor holding brakes and operational brakes.

The brake is controlled as follows (the sequence reflects the priority):

- Via parameter p1215
- Via binector parameters p1219[0..3] and p0855
- Via zero speed detection
- Via a connector interconnection threshold value

9.3.2.2 Commissioning

The "extended braking control" function module can be activated by running the commissioning Wizard. Parameter r0108.14 indicates whether the function module has been activated.

Parameter p1215 must be set to "3" and the brake activated via a digital output on customer terminal block TM31.

Function Diagrams

FD 2704 Zero speed detection

FD 2707 Release/apply brake

FD 2711 Signal outputs

9.3.2.3 Examples

Starting Against Applied Brake

When the device is switched on, the setpoint is enabled immediately (if other enable signals are issued), even if the brake has not yet been released (p1152 = 1). The factory setting p1152 = r0899.15 must be separated here. The drive first generates torque against the applied brake. The brake is not released until the motor torque or motor current (p1220) has exceeded braking threshold 1 (p1221).

This configuration is used, for example, when the drive is connected to a belt that is under tension (loop accumulator in the steel industry).

Emergency Brake

If emergency braking is required, electrical and mechanical braking is to take place simultaneously. This can be achieved if OFF3 is used as a tripping signal for emergency braking:

p1219[0] = r0898.2 (OFF3 to "apply brake immediately").

This is often used, for example, in calendar stacks, cutting tools, running gears, and presses.

9.3.3 Extended Monitoring Functions

9.3.3.1 Description

The "extended monitoring functions" function module enables additional monitoring functions:

- Speed setpoint monitoring: |n_set| <= p2161
- Speed setpoint monitoring: n_set > 0
- Load monitoring

Load Monitoring

This function monitors power transmission between the motor and the working machine. Typical applications include V-belts, flat belts, or chains that loop around the belt pulleys or cog wheels for drive and outgoing shafts and transfer the peripheral speeds and forces. Load monitoring can be used here to identify blockages in the working machine and interruptions to the power transmission. During load monitoring, the current speed/torque curve is compared with the programmed speed/torque curve (p2182 – p2190). If the current value is outside the programmed tolerance bandwidth, a fault or alarm is triggered depending on parameter p2181. The fault or alarm message can be delayed by means of parameter p2192 to prevent false alarms caused by brief transitional states.

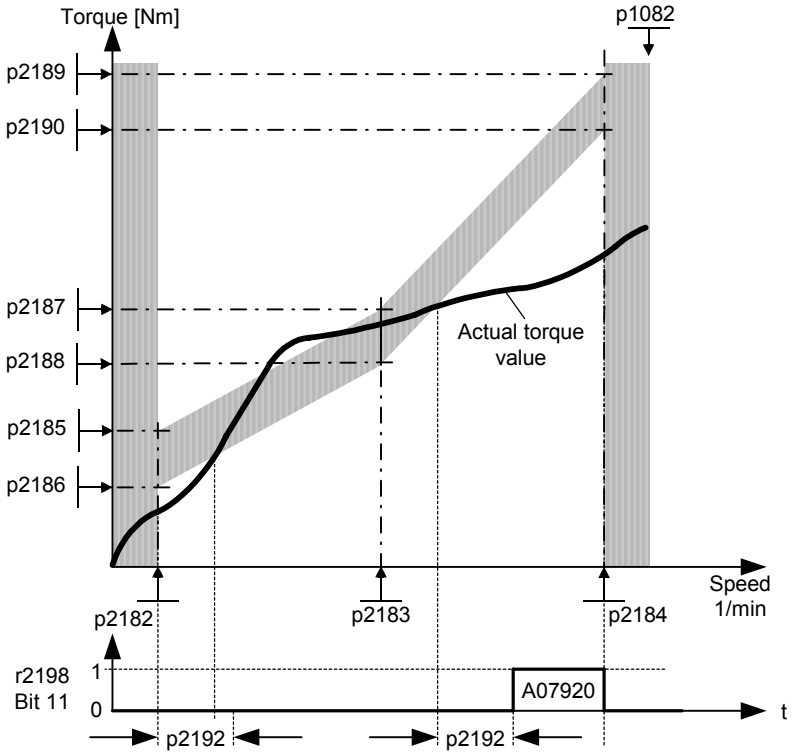


Fig. 9-10 Load monitoring (p2181 = 1)

9.3.3.2 Commissioning

The "extended monitoring functions" function module can be activated by running the commissioning Wizard. Parameter r0108.17 indicates whether the function module has been activated.

Function Diagrams

FD 8010 Speed messages

FD 8013 Load monitoring

9.4 Monitoring and Protection Functions

9.4.1 Protecting Power Components: General

Description

SINAMICS power sections offer comprehensive functions for protecting power components.

Table 9-5 General protection for power components

Protection against:	Protective measure	Response
Overcurrent [1]	Monitoring with two thresholds:	
	• First threshold exceeded	A30031, A30032, A30033 Current limitation of phase activated. Pulsing in the phase in question is inhibited for one pulse period. F30017 -> OFF2 is triggered if the threshold is exceeded too often.
	• Second threshold exceeded	F30001 "Overcurrent" -> OFF2
Overvoltage [1]	Comparison of DC link voltage with hardware shutdown threshold	F30002 "Overvoltage" -> OFF2
Undervoltage [1]	Comparison of DC link voltage with hardware shutdown threshold	F30003 "Undervoltage" -> OFF2
Short-circuit [1]	• Second monitoring threshold checked for overcurrent	F30001 "Overcurrent" -> OFF2
	• U_{ce} monitoring for IGBT module	F30022 "Monitoring U_{ce}" -> OFF2
Ground fault	Monitoring the sum of all phase currents	After threshold in p0287 is exceeded: F30021 "Power section: ground fault" -> OFF2 Note: The sum of all phase currents is displayed in r0069[6]. For operation, the value in p0287[1] must be greater than the sum of the phase currents when the insulation is intact.
Line phase-failure detection [1]		F30011 "Line phase-failure in main circuit" -> OFF2

[1] The monitoring thresholds are permanently defined in the converter and cannot be changed by the user.

9.4.2 Thermal Monitoring and Overload Responses

Description

The priority of thermal monitoring for power components is to identify critical situations. If alarm thresholds are exceeded, the user can set parameterizable response options that enable continued operation (e.g. with reduced power) and prevent immediate shutdown. The parameterization options, however, only enable intervention below the shutdown thresholds, which cannot be changed by the user.

The following thermal monitoring options are available:

- i²t monitoring – A07805 – F30005
  i²t monitoring is used to protect components that have a high thermal time constant compared with semi-conductors. Overload with regard to i²t is present when the converter load (r0036) is greater than 100% (load in % in relation to rated operation).
- Heat-sink temperature – A05000 – F30004
  Monitoring of the heat-sink temperature (r0037) of the power semi-conductor (IGBT).
- Chip temperature – A05001 – F30025
  Significant temperature differences can occur between the IGBT barrier junction and the heat sink. These differences are taken into account and monitored by the chip temperature (r0037).

If an overload occurs with respect to any of these three monitoring functions, an alarm is first output. The alarm threshold p0294 (i²t monitoring) can be parameterized relative to the shutdown (trip) values.

Example

The factory setting for the alarm threshold for chip temperature monitoring is 15°C. Temperature monitoring for the heat sink and inlet air is set to 5°C, that is, the "Overtemperature, overload" alarm is triggered at 15°C or 5°C below the shutdown threshold.

The parameterized responses are induced via p0290 simultaneously when the alarm is output. Possible responses include:

- Reduction in pulse frequency (p0290 = 2, 3)
  This is a highly effective method of reducing losses in the power section, since switching losses account for a high proportion of overall losses. In many applications, a temporary reduction in pulse frequency is tolerable in order to maintain the process.
  Disadvantage:
  Reducing the pulse frequency increases the current ripple which, in turn, can increase the torque ripple on the motor shaft (with low inertia load), thereby increasing the noise level. Reducing the pulse frequency does not affect the dynamic response of the current control circuit, since the sampling time for the current control circuit remains constant.

- Reducing the output frequency (p0290 = 0, 2)
  This variant is recommended when you do not need to reduce the pulse frequency or the pulse frequency has already been set to the lowest level. The load should also have a characteristic similar to a fan, that is, a quadratic torque characteristic with falling speed. Reducing the output frequency has the effect of significantly reducing the converter output current which, in turn, reduces losses in the power section.
- No reduction (p0290 = 1)
  You should choose this option when a reduction in neither pulse frequency nor output current is necessary. The converter does not change its operating point once an alarm threshold has been overshot, which means that the drive can be operated until it reaches its shutdown values. Once it reaches its shutdown threshold, the converter switches itself off and the "Overtemperature, overload" fault is output. The time until shutdown, however, is not defined and depends on the degree of overload. To ensure that an alarm can be output earlier or that the user can intervene, if necessary, in the drive process (e.g. reduce load/ambient temperature), only the alarm threshold can be changed.

Function Diagram

FD 8014

Parameters

- p0290 Power module overload response
- p0294 Power module alarm with i²t overload
- r0036 Power module overload
- r0037 Power module temperatures

9.4.3 Block Protection

Description

The error message "Motor blocked" is only triggered if the speed of the drive is below the variable speed threshold set in p2175. With vector control, it must also be ensured that the speed controller is at the limit. With V/f control, the current limit must already have been reached.
Once the ON delay (p2177) has elapsed, the message "Motor blocked" and fault F7900 are generated.

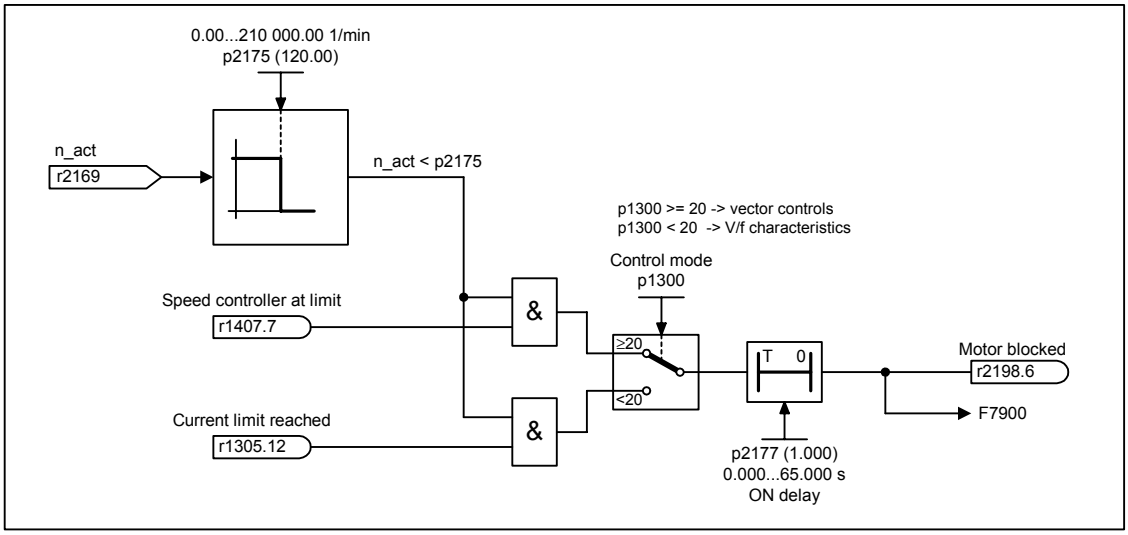


Fig. 9-11 Block protection

Function Diagram

FD 8012

Parameters

- p2175 Motor blocked speed threshold
- p2177 Motor blocked delay time

9.4.4 Stall Protection (Vector Control Only)

Description

If a stalled drive is detected (p1408.12 set), fault 7902 is output after the delay time set in P2178.

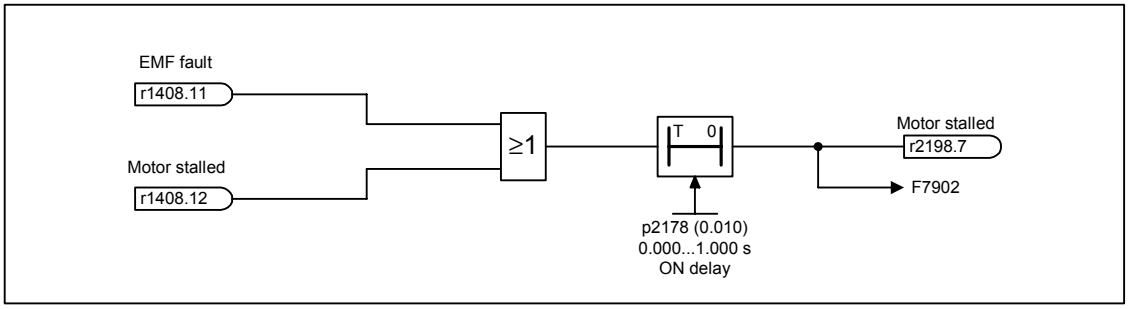


Fig. 9-12 Stall protection

Function Diagram

FD 8012

Parameter

- p2178 Motor stalled delay time

9.4.5 Thermal Motor Protection

Description

The priority of thermal motor protection is to identify critical situations. If alarm thresholds are exceeded, the user can set parameterizable response options (p0610) that enable continued operation (e.g. with reduced power) and prevent immediate shutdown.

The signal characteristic is shown in plan 902.

- Effective protection is also possible without a temperature sensor (p4100 = 0). The temperatures of different motor components (stators, core, rotors) can be determined indirectly using a temperature model.
- Connecting temperature sensors (KTY84 or PTC100 to the customer terminal block (TM31) terminal X522:7(+)/8(-)) allows the motor temperature to be determined directly. In this way, accurate start temperatures are available immediately when the motor is switched on again or after a power failure.

Temperature Measurement via KTY

The device is connected to terminals X522:7 (anode) and X522:8 (cathode) on the customer terminal block in the forward direction of the diode. The measured temperature is limited to between –48°C and +248°C and is made available for further evaluation.

- Set the KTY temperature sensor type: p4100 = 2
- Activate motor temperature measurement via the external sensor: p0600 = 10
- When the alarm threshold is reached (set via p0604; factory setting: 120°C), alarm A7910 is triggered.

  Parameter p0610 can be used to set how the drive responds to the alarm triggered:

  - 0: No response, only alarm, no reduction of I_max
  - 1: Alarm with reduction of I_max and fault (F7011)
  - 2: Alarm and fault (F7011), no reduction of I_max
- When the fault threshold is reached (set via p0605; factory setting: 155°C), fault F7011 is triggered in conjunction with the setting in p0610.

Temperature Measurement via PTC

The device is connected to terminal X522:7/8 on the customer terminal block (TM31). The threshold for switching to an alarm or fault is 1650 Ω. If the threshold is exceeded, the system switches internally from an artificially-generated temperature value of –50°C to +250°C and makes it available for further evaluation.

- Set the KTY temperature sensor type: p4100 = 1
- Activate motor temperature measurement via the external sensor: p0600 = 10
- Alarm A7910 is triggered once the PTC responds.
- Fault F7011 is triggered once the waiting time defined in p0606 has elapsed.

Sensor Monitoring for Cable Breakage / Short-Circuit

If the temperature of the motor temperature monitor is outside the range –50°C to +250°C, the sensor cable is broken or has short-circuited. Alarm A07915 ("Alarm: temperature sensor fault") is triggered. Fault F07016 (“Fault: temperature sensor fault”) is triggered once the waiting time defined in p0607 has elapsed.

Fault F07016 can be suppressed by p0607 = 0. If an induction motor is connected, the drive continues operating with the data calculated in the thermal motor model.

If the system detects that the motor temperature sensor set in p0600 is not connected, alarm A07820 ("Temperature sensor not connected") is triggered.

Function Diagram

FP 8016, 9576, 9577

Parameters

- p0600 Motor temperature sensor for monitoring
- p0604 Motor overtemperature fault threshold
- p0605 Motor overtemperature alarm threshold
- p0606 Motor overtemperature timer
- p0607 Temperature sensor fault timer
- p0610 Response to motor overtemperature condition
- p4100 TM31 temperature evaluation sensor type

■

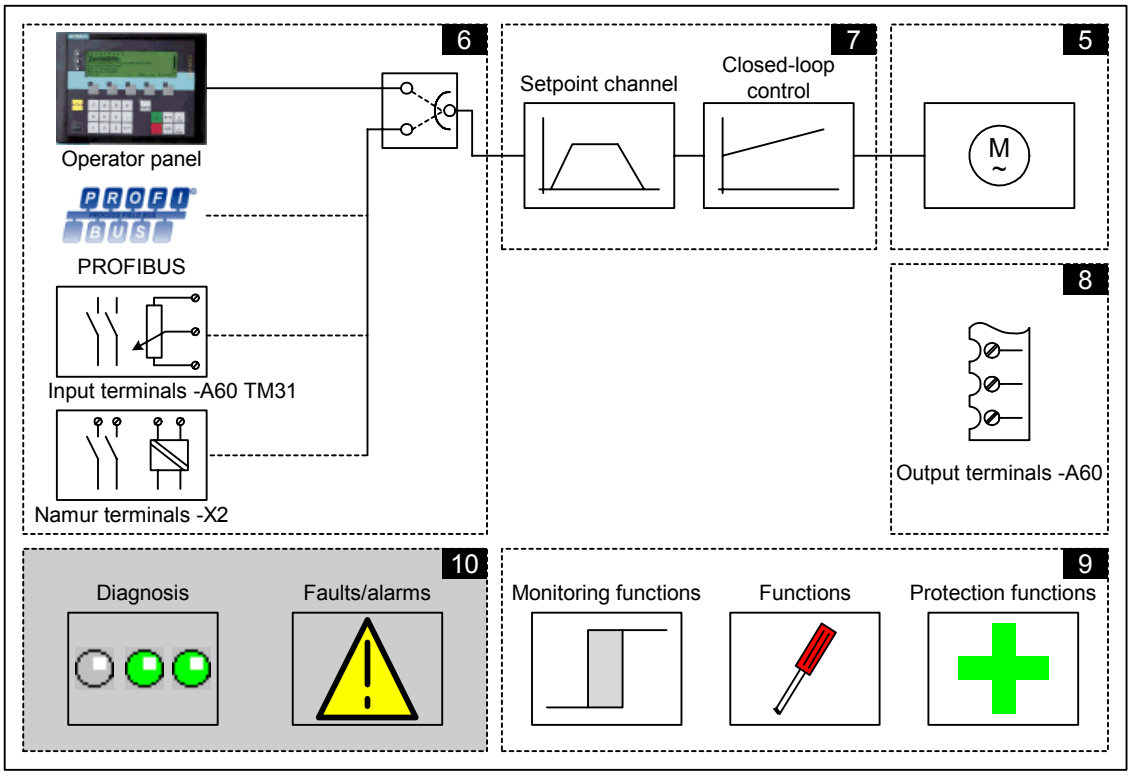
Diagnosis / Faults and Alarms

10

10.1 Chapter Content

This chapter provides information on the following:

- Troubleshooting
- Service and support offered by Siemens AG



10.2 Diagnosis

Description

This section describes procedures for identifying the causes of problems and the measures you need to take to rectify them.

NOTE

If errors or malfunctions occur in the cabinet unit, you must carefully check the possible causes and take the necessary steps to rectify them. If you cannot identify the cause of the problem or you discover that components are defective, your regional office or sales office should contact Siemens Service and describe the problem in more detail.

10.2.1 Diagnosis Using LEDs

CU320 Control Unit (-A10)

Table 10-1 Description of the LEDs on the CU320

LED	Color	Status	Description
RDY (ready)	---	OFF	Electronics power supply outside permissible tolerance range
	Green	Continuous	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
		Flashing 2 Hz	Writing to CompactFlash card.
	Red	Continuous	At least one fault is present in this component.
		Flashing 0.5 Hz	CompactFlash Card is not inserted. Boot error (e.g. firmware cannot be loaded to RAM).
	Green Red	Flashing 0.5 Hz	Control unit 320 is ready. No software licenses for the device
	Orange	Continuous	DRIVE-CLiQ communication is being established.
		Flashing 0.5 Hz	Unable to load firmware to RAM.
		Flashing 2 Hz	Firmware CRC error

LED	Color	Status	Description
DP1 (PROFIBUS cyclic operation)	---	OFF	Cyclic communication has not (yet) taken place. Note: PROFIBUS is ready for communication when the control unit is ready (see LED RDY).
	Green	Continuous	Cyclic communication is taking place.
		Flashing 0.5 Hz	Full cyclic communication is not yet taking place. Possible causes: • The master is not transmitting setpoints. • No global control (GC) or master sign-of-life is transmitted during isochronous operation.
	Red	Continuous	Cyclic communication has been interrupted.
OPT (option)	---	OFF	Electronics power supply outside the permissible tolerance range. The component is not ready for operation. Option board not installed or no associated drive object has been created.
	Green	Continuous	Option board is ready.
		Flashing 0.5 Hz	Depends on the option board used.
	Red	Continuous	At least one fault is present in this component. Option board not ready (e.g. after power-on).
MOD	---	OFF	Reserved
	Green	Continuous	Reserved

Customer Terminal Block TM31 (-A60)

Table 10-2 Description of the LEDs on the TM31

LED	Color	Status	Description
RDY	---	OFF	The electronics power supply is missing or lies outside permissible tolerance range.
	Green	Continuous	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
	Orange	Continuous	DRIVE-CLiQ communication is being established.
	Red	Continuous	At least one fault is present in this component.
	Green Red	Flashing 2 Hz	Firmware is being downloaded.
	Grün Orange or Rot Orange	Flashing 2 Hz	Component recognition via LED is activated (p0144) Note: Both options depend on the LED status when module recognition is activated via p0154 = 1.

Control Interface Board – Interface Module in the Power Module (-U1)

Table 10-3 Description of the LEDs on the control interface board

LED state		Description
H200	**H201**	
Off	Off	The electronics power supply is missing or lies outside permissible tolerance range.
Green	Off	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high.
Orange	Orange	DRIVE-CLiQ communication is being established.
Red	---	At least one fault is present in this component.
2 Hz flashing light Green / red	---	Firmware is being downloaded.
2 Hz flashing light Green orange or red orange	---	Component detection using LED is activated (p0124) Note: Both options depend on the LED status when component recognition is activated via p0124 = 1.

CAUTION

Independent of the state of LED "H201", hazardous DC link voltages can always be available.
The warning information on the components must be carefully observed!

SMC30 – Encoder Evaluation (-A81)

Table 10-4 Description of the LEDs on the SMC30

LED	Color	Status	Description
RDY	---	OFF	The electronics power supply is missing or lies outside permissible tolerance range
	Green	Steady light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
	Orange	Steady light	DRIVE CLiQ communication is being established.
	Red	Steady light	At least one fault is present in this component.
	Green / red	2 Hz flashing light	Firmware is being downloaded.
	Green / orange or Red / orange	2 Hz flashing light	Component recognition via LED is activated (p0144) Note: Both options depend on the LED status when component recognition is activated via p0144 = 1.
OUT>5 V	---	OFF	The electronics power supply is missing or lies outside permissible tolerance range Measuring system supply ≤ 5 V (only when ready for operation).
	Orange	Steady light	Electronics power supply for the measuring system is available. Measuring system supply > 5 V. **Notice:** It must be guaranteed that the connected encoder may be operated with a 24 V power supply. If an encoder designed for connection to 5 V is connected to 24 V, then this can destroy the encoder electronics.

10.2.2 Diagnosis via Parameters

All Objects: Key Diagnostic Parameters (Details in List Manual)

r0945	Fault code
Displays the fault number. Index 0 is the most recent fault (last fault to have occurred).	

r0949	Fault value
Displays additional information about the fault. This information is required for detailed fault diagnosis.	

r0948	Time that the fault comes in milliseconds
Displays the system runtime in ms at which the fault occurred.	

r2109	Time that the fault has cleared in milliseconds
Displays the system runtime in ms at which the fault was rectified.	

r2124	Alarm value
Displays additional information about the alarm. This information is required for detailed alarm diagnosis.	

r2123	Time that the alarm came in milliseconds
Displays the system runtime in ms at which the alarm occurred.	

r2125	Time that the alarm has been cleared in milliseconds
Displays the system runtime in ms at which the alarm was rectified.	

CU320: Key Diagnostic Parameters (Details in List Manual)

r0002	Operating display
Operating display for the CU.	

r0018	Control Unit firmware version
Displays the firmware version of the Control Unit. For the display parameters for the firmware version of the other connected components, see the parameter description in the List Manual.	

r0721	Digital inputs terminal actual value
Displays the actual value at the digital input terminals on the CU. This parameter shows the actual value, uninfluenced by simulation mode of the digital inputs.	

r0722	Digital inputs status (CU)
Displays the status of the digital inputs on the CU. This parameter shows the status of the digital inputs under the influence of simulation mode of the digital inputs.	

r0747	Digital outputs status (CU)
Displays the status of the digital outputs on the CU. This parameter shows the status of the digital inputs under the influence of simulation mode of the digital inputs.	

r2054	Profibus status
Displays the status of the Profibus interface	

r9976[0..7]	System load
Displays the system load. The individual values (computation load and cyclic load) are measured over short time slices; from these values, the maximum, the minimum and the average value are generated and displayed in the appropriate indices. Further, the degree of memory utilization of the data and program memory is displayed.	

Vector: Key Diagnostic Parameters (Details in List Manual)

r0002	Operating display
The value provides information about the current operating status and the conditions necessary to reach the next status.	

r0020	Speed setpoint smoothed
Displays the actual smoothed speed/velocity setpoint at the input of the speed/velocity controller or V/f characteristic (after the interpolator).	

r0021	Speed setpoint smoothed
Displays the smooth actual value of the motor speed/velocity.	

r0026	DC link voltage smoothed
Displays the smoothed actual value of the DC link.	

r0027	Absolute actual current smoothed
Displays the smoothed actual value of the current.	

r0031	Actual torque smoothed
Displays the smoothed actual torque.	

r0035	Motor temperature
Displays the actual temperature in the motor. If neither a temperature sensor nor a PTC thermistor are connected, the temperature of the thermal motor model is displayed (r0632).	

r0037	Power module temperatures
Displays the measured temperatures in the power module.	

r0046	Missing drive enable signals
Displays missing enable signals that are preventing commissioning.	

r0050	Active command data set (CDS)
Displays the active command data set (CDS)	

r0206	Rated power module power
Displays the rated power module power for various load duty cycles.	

r0207	Rated power module current
Displays the rated power module power for various load duty cycles.	

r0208	Rated line supply voltage of power module
Displays the rated line supply voltage of the power module.	

TM31: Key Diagnostic Parameters (Details in List Manual)

r0002	Operating display
Operating display for the TM31.	

r4021	Digital inputs actual terminal value
Displays the actual value on the digital input terminals on the TM31. This parameter shows the actual value, uninfluenced by simulation mode of the digital inputs.	

r4022	Status of digital inputs
Displays the status of the digital inputs on the TM31. This parameter shows the status of the digital inputs under the influence of simulation mode of the digital inputs.	

r4047	Digital outputs status
Displays the status of the digital outputs on the TM31. Inversion via p4048 is taken into account.	

Additional diagnostic parameters for cabinet units with power rating (for details, refer to the List Manual)

For the following cabinet units, there are additional diagnostic parameters that provide detailed information about individual Power Modules for a parallel circuit configuration.

- for 3-ph. 380 V – 480 V AC:
  6SL3710-2GE41-1AA0, 6SL3710-2GE41-4AA0, 6SL3710-2GE41-6AA0
- for 3-ph. 500 V – 600 V AC:
  6SL3710-2GF38-6AA0, 6SL3710-2GF41-1AA0, 6SL3710-2GF41-4AA0
- for 3-ph. 660 V – 690 V AC:
  6SL3710-2GH41-1AA0, 6SL3710-2GH41-4AA0, 6SL3710-2GH41-5AA0

r7000 - r7322	Special parameters for Power Modules in a parallel circuit configuration

10.2.3 Indicating and Rectifying Faults

The cabinet unit features a wide range of functions that protect the drive against damage if a fault occurs (faults and alarms).

Indicating Faults and Alarms

If a fault occurs, the drive indicates the fault and/or alarm on the cabinet operator panel. Faults are indicated by the red "FAULT" LED and a fault screen is automatically displayed. You can use the F1 Help function to call up information about the cause of the fault and how to remedy it. To acknowledge a stored fault, choose F5 Ack.

Any alarms are displayed by the yellow flashing "ALARM" LED. The system also displays a note in the status bar providing information on the cause.

Every fault and alarm is entered in the fault/alarm buffer along with time the error occurred and the time it was rectified. The time stamp relates to the relative system time in milliseconds (r0969).

What is a Fault?

A fault is a message from the drive indicating an error or other exceptional (unwanted) status. This could be caused by a fault within the converter or an external fault triggered, for example, from the winding temperature monitor for the asynchronous motor. The faults are displayed and can be reported to a higher-level control system via PROFIBUS. In the factory default setting, the message "converter fault" is also sent to a relay output. Once you have rectified the cause of the fault, you have to acknowledge the fault message.

What is an Alarm?

An alarm is the response to a fault condition identified by the drive. It does not result in the drive being switched off and does not have to be acknowledged. Alarms are "self acknowledging", that is, they are reset automatically when the cause of the alarm has been eliminated.

10.3 Overview of Faults and Alarms

If a fault occurs, the drive indicates the fault and/or alarm. Faults and alarms are listed in a fault/alarm list, together with the following information:

- Fault/alarm number
- Standard drive response
- Description of the possible cause of the fault/alarm
- Description of the procedure for rectifying the problem
- Standard fault acknowledgement after it has been rectified

NOTE

The fault/alarm list is contained on the documentation CD supplied.

It also contains descriptions of the responses (OFF1, OFF2, etc.).

10.3.1 "External Warning 1"

Causes

Warning A7850 ("External Warning 1") is triggered by the following optional protection devices in the cabinet unit:

- Thermistor motor protection unit alarm (option L83)
- PT100 Evaluation Unit (Option L86)

Remedy

When a fault is indicated, the following procedure is recommended:

1. Identify the cause by examining the specified devices (display or LEDs).
2. Check the fault display on the relevant protection device and establish the fault.
3. Rectify the displayed fault with the help of the appropriate operating instructions provided in "Additional Operating Instructions".

10.3.2 "External Fault 1"

Causes

Fault code F7860 ("External Fault 1") is triggered by the following optional protection devices in the cabinet unit:

- Thermistor motor protection unit shutdown (option L84)
- PT100 Evaluation Unit (Option L86)

Remedy

When a fault is indicated, the following procedure is recommended:

Identify the cause by examining the specified devices (display or LEDs).

4. Check the fault display on the relevant protection device and establish the fault.
5. Rectify the displayed fault with the help of the appropriate operating instructions provided in "Additional Operating Instructions".

10.3.3 "External Fault 3"

Causes

Fault code F7862 ("External Fault 3") is triggered when the braking resistor available with options L61 and L62 is subject to thermal overload, thereby activating the thermostat. The drive is switched off with OFF2.

Remedy

The cause of the braking resistor overload must be eliminated and the fault code acknowledged.

10.4 Service and Support

Service and Support Helpline

If you need help and do not know who to contact, we make sure that you receive all the help you need as quickly as possible.

The helpline ensures that a specialist in your area can provide you with professional support. The helpline (in Germany, for example) is available 24 hours a day, 365 days a year. German and English are spoken.

Tel.: 0180 50 50 111

Online support

Our round-the-clock, worldwide online support service provides quick and efficient support in five languages. The comprehensive Internet-based information system, which is available round the clock, provides product support, services, and support tools in the shop.

Online support provides a wide range of technical information:

- FAQs, tips and tricks, downloads, current news
- Manuals
- Helpful programs and software products

http://www.siemens.de/automation/service&support

Field Service

If your plant is down and you need fast, on-site help, we can provide the specialists with the required expertise wherever you are.

With our comprehensive service network, we offer professional and reliable expertise to get your plant up and running again as quickly as possible.

Experts are available 24 hours a day, 365 days a year.

Tel.: 0180 50 50 444

Of course, we can also arrange special service contracts tailored to your specific requirements. For details, please contact your Siemens office.

Spare Parts and Repairs

Our global network of regional spare parts warehouses and repair centers enables us to respond quickly and reliably with modern logistics procedures.

During the operational phase of your machinery, we provide a comprehensive repairs and spare parts service to ensure maximum operational reliability. Our service includes expert advice with technical problems, and a wide range of product and system support services tailored to your needs.

For more information about repairs or spare parts, please call the following number (in Germany):

Tel.: 0180 50 50 448

You can call this number outside office hours and at the weekend to contact our emergency spare parts service.

Technical support

We offer technical support in both German and English for deploying products, systems, and solutions in drive and automation technology.

In special cases, help is available from professional, trained, and experienced specialists via teleservice and video conferencing.

Free Contact – providing you with free technical support

- In Europe / Africa
  Tel.: +49 (0)180 50 50 222
  Fax: +49 (0)180 50 50 223
  Internet: http://www.siemens.com/automation/support-request
- in America
  Tel.: +14232622522
  Fax: +14232622289
  E-mail: simatic.hotline@sea.siemens.com
- Asia / Pacific region
  Tel.: +86 1064 757575
  Fax: +86 1064 747474
  E-mail: adsupport.asia@siemens.com

■

Maintenance and Servicing 11

11.1 Chapter Content

This chapter provides information on the following:

- Maintenance and servicing procedures that have to be carried out on a regular basis to ensure the availability of the cabinet unit
- Exchanging device components when the unit is serviced
- Reforming the DC link capacitors
- Upgrading the cabinet unit firmware
- Load the new operator panel firmware and database from the PC.

DANGER

Before carrying out any maintenance or repair work on the de-energized cabinet unit, wait for 5 minutes after switching off the supply voltage. This allows the capacitors to discharge to a harmless level (< 25 V) after the supply voltage has been switched off.

Before starting work, you should also measure the voltage after the 5 minutes have elapsed. The voltage can be measured on DC link terminals DCP and DCN.

DANGER

When the external power supply for individual options (L50 / L55) or the external 230 V AC auxiliary supply is connected, dangerous voltages are still present in the cabinet unit even when the main circuit-breaker is open.

11.2 Maintenance

The cabinet unit mainly comprises electronic components. Apart from the fan(s), the unit contains very few components that are subject to wear or require maintenance or servicing. Maintenance aims to preserve the specified condition of the cabinet unit. Dirt and contamination must be removed regularly and parts subject to wear replaced.

The following points must generally be observed.

11.2.1 Cleaning

Dust Deposits

Dust deposits inside the cabinet unit must be removed at regular intervals (or at least once a year) by qualified personnel in line with the relevant safety regulations. The unit must be cleaned using a brush and vacuum cleaner, and dry compressed air (max. 1 bar) for areas that cannot be easily reached.

Ventilation

The ventilation openings in the cabinet must never be obstructed. The fan must be checked to make sure that it is functioning correctly.

Cable and Screw Terminals

Cable and screw terminals must be checked regularly to ensure that they are secure in position, and if necessary, retightened. Cabling must be checked for defects. Defective parts must be replaced immediately.

NOTE

The actual intervals at which maintenance procedures are to be performed depend on the installation conditions (cabinet environment) and the operating conditions.

Siemens offers its customers support in the form of a service contract. For further details, contact your regional office or sales office.

11.3 Servicing

Servicing involves activities and procedures for maintaining and restoring the operating condition of the cabinet unit.

Required Tools

The following tools are required for replacing components:

- Spanner or socket spanner (w/f 10)
- Spanner or socket spanner (w/f 13)
- Spanner or socket spanner (w/f 16/17)
- Spanner or socket spanner (w/f 18/19)
- Hexagon-socket spanner (size 8)
- Torque spanner, max. 50 Nm
- Screwdriver size 1 / 2
- Screwdriver Torx T20
- Screwdriver Torx T30

Tightening Torques for Current-Carrying Parts

When securing connections for current-carrying parts (DC link, motor connections, busbars), you must observe the following tightening torques.

Table 11-1 Tightening torques for connecting current-carrying parts

Screw	Torque
M8	13 Nm
M10	25 Nm
M12	50 Nm

11.3.1 Installation Device

Description

The installation device is used for installing and removing the power blocks.

It is used as an installation aid, which is placed in front of and secured to the module. The telescopic guide support allows the withdrawable device to be adjusted according to the height at which the power blocks are installed. Once the mechanical and electrical connections have been removed, the power block can be removed from the module, whereby the power block is guided and supported by the guide rails on the withdrawable devices.

Fig. 11-1 Installation device

Order Number

Order number for the installation device: 6SL3766-1FA00-0AA0

11.4 Replacing Components

WARNING

The following must be taken into account when the devices are transported:

- Some of the devices are heavy or top heavy.
- Due to their weight, the devices must be handled with care by trained personnel.
- Serious injury or even death and substantial material damage can occur if the devices are not lifted or transported properly.

WARNING

The cabinet units are operated with high voltages.
All connection procedures must be carried out with the cabinet de-energized.
All work on the units must be carried out by trained personnel only. Death, serious injury, or substantial material damage can result if these warnings are not taken into account.
Work on an open device must be carried out with extreme caution because external supply voltages may be present. The power and control terminals may be live even when the motor is not running.
Dangerously high voltage levels are still present in the cabinet up to five minutes after it has been disconnected due to the DC link capacitors. For this reason, the cabinet should not be opened until after a reasonable period of time has elapsed.

11.4.1 Replacing the Filter Mats (Options M23 and M54)

The filter mats must be checked at regular intervals. If the mats are too dirty to allow the air supply to flow normally, they must be replaced.

NOTE

This section is only relevant for options M23 and M54.

Not replacing contaminated filter mats can cause premature drive shutdown.

11.4.2 Replacing the Power Block (Type FX)

Replacing the Power Block

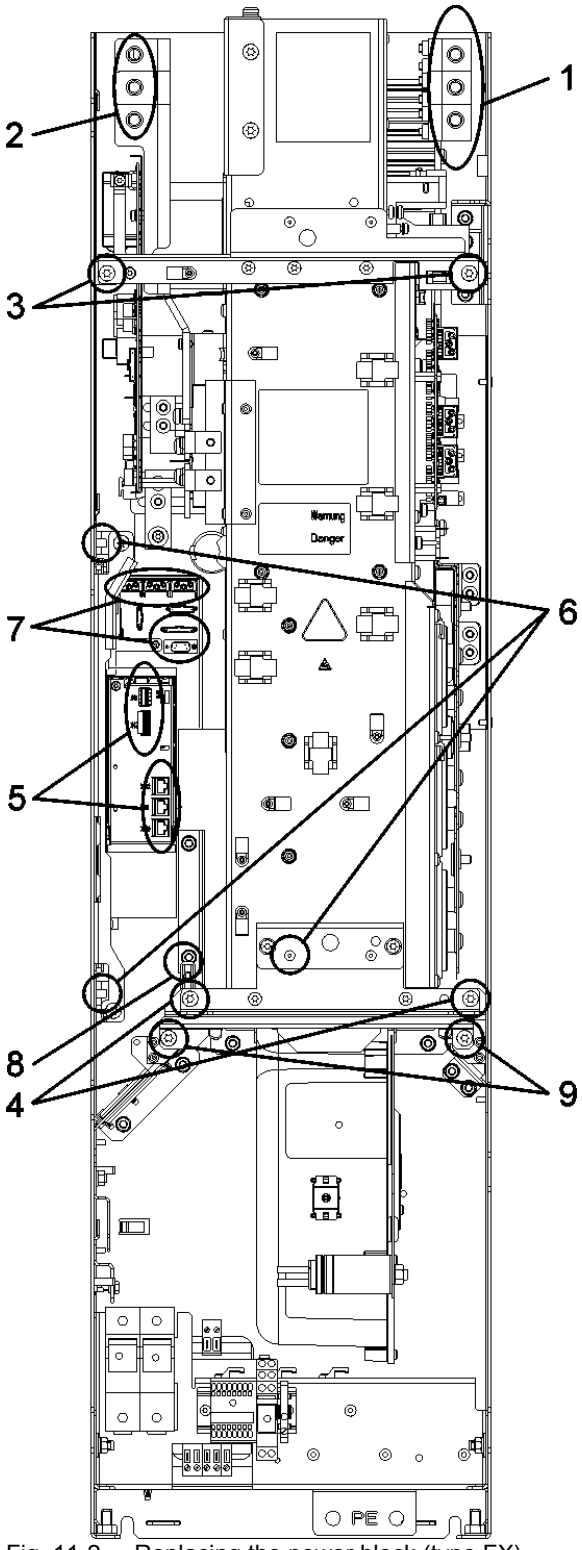


Fig. 11-2 Replacing the power block (type FX)

Preparatory Steps

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access to the power block.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-2.

1. Unscrew the connection to the outgoing motor section (3 screws).
2. Unscrew the connection to the mains supply (4 screws).
3. Remove the retaining screws at the top (2 screws).
4. Remove the retaining screws at the bottom (2 screws).
5. Remove the DRIVE-CLiQ cables and connections to the CU320 (5 plugs).
6. Remove the CU320 mounts (1 screw and 2 nuts). If necessary, remove the PROFIBUS plug and connection to the operator panel (-X140 on the CU320) and remove the CU320.
7. Disconnect the plugs for the fiber optic cables and signal cables (5 plugs).
8. Disconnect the plug for the thermocouple.
9. Unscrew the two retaining screws for the fan and attach the installation device for the power block at this position.

You can now remove the power block.

CAUTION

When removing the power block, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.3 Replacing the Power Block (Type GX)

Replacing the Power Block

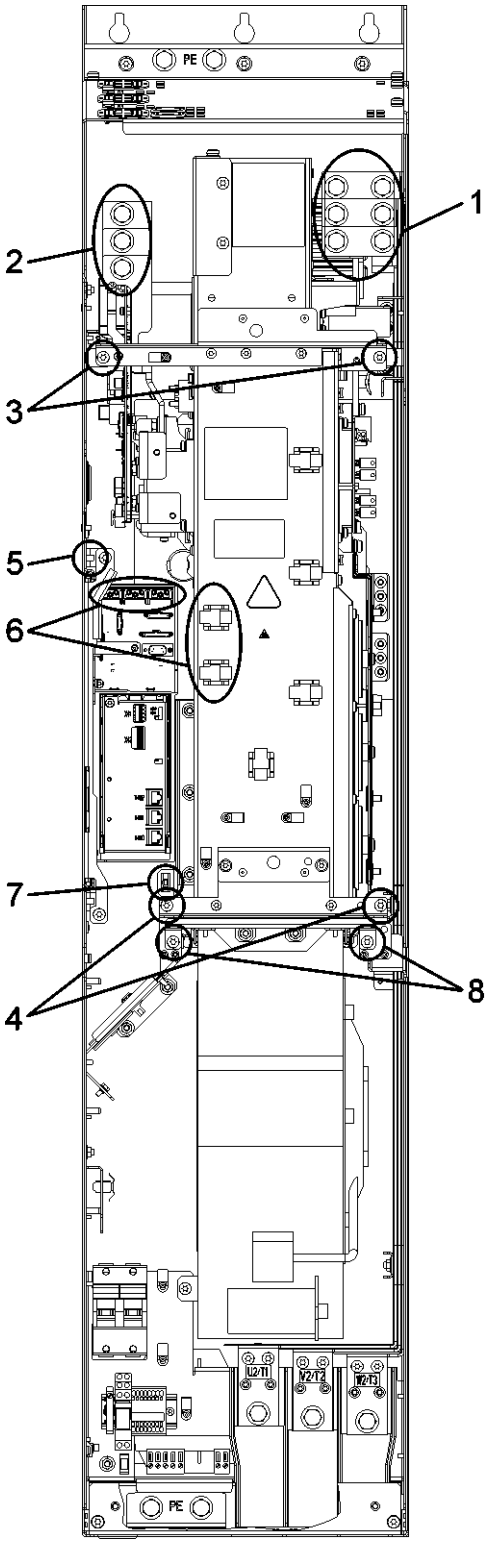


Fig. 11-3 Replacing the power block (type GX)

Preparatory Steps

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access to the power block.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-3.

1. Unscrew the connection to the outgoing motor section (3 screws).
2. Unscrew the connection to the mains supply (3 screws).
3. Remove the retaining screws at the top (2 screws).
4. Remove the retaining screws at the bottom (2 screws).
5. Remove the CU320 mount (1 nut). If necessary, remove the PROFIBUS plug and connection to the operator panel (-X140 on the CU320) and carefully remove the CU320.
6. Disconnect the plugs for the fiber optic cables (5 plugs) and release the cable connection for the signal cables (2 connectors).
7. Disconnect the plug for the thermocouple.
8. Unscrew the two retaining screws for the fan and attach the installation device for the power block at this position.

You can now remove the power block.

CAUTION

When removing the power block, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.4 Replacing the Power Block (Type HX)

Replacing the Left-Hand Power Block

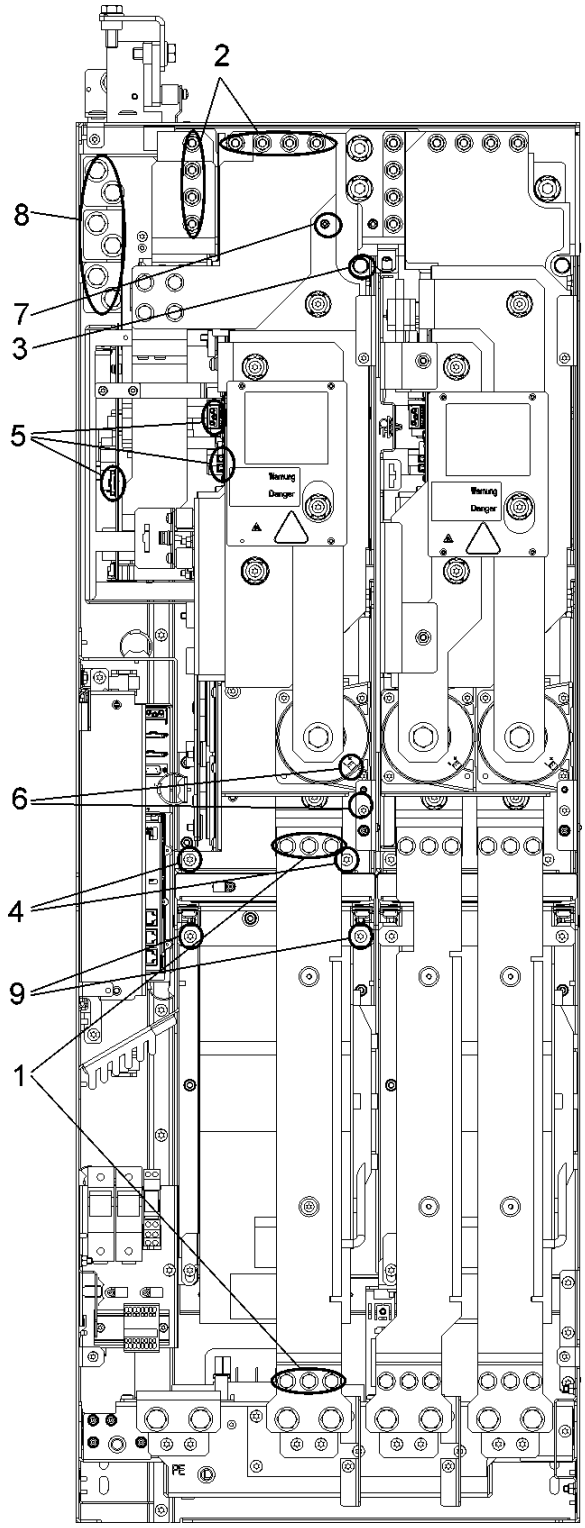


Fig. 11-4 Replacing the power block (type HX) (left-hand power block)

Preparatory Steps

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access to the power block.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-4.

1. Remove the busbar (6 screws).
2. Unscrew the connection to the DC link (8 nuts).
3. Remove the retaining screw at the top (1 screw).
4. Remove the retaining screws at the bottom (2 screws).
5. Disconnect the plugs for the fiber optic cables and signal cables (3 plugs).
6. Remove the connection for the current transformer and associated PE connection (1 plug).
7. Remove the connection for the DC link sensor (1 nut).
8. Remove the power connections (6 screws).
9. Unscrew the two retaining screws for the fan and attach the installation device for the power block at this position.

You can now remove the power block.

CAUTION

When removing the power block, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

Replacing the Right-Hand Power Block

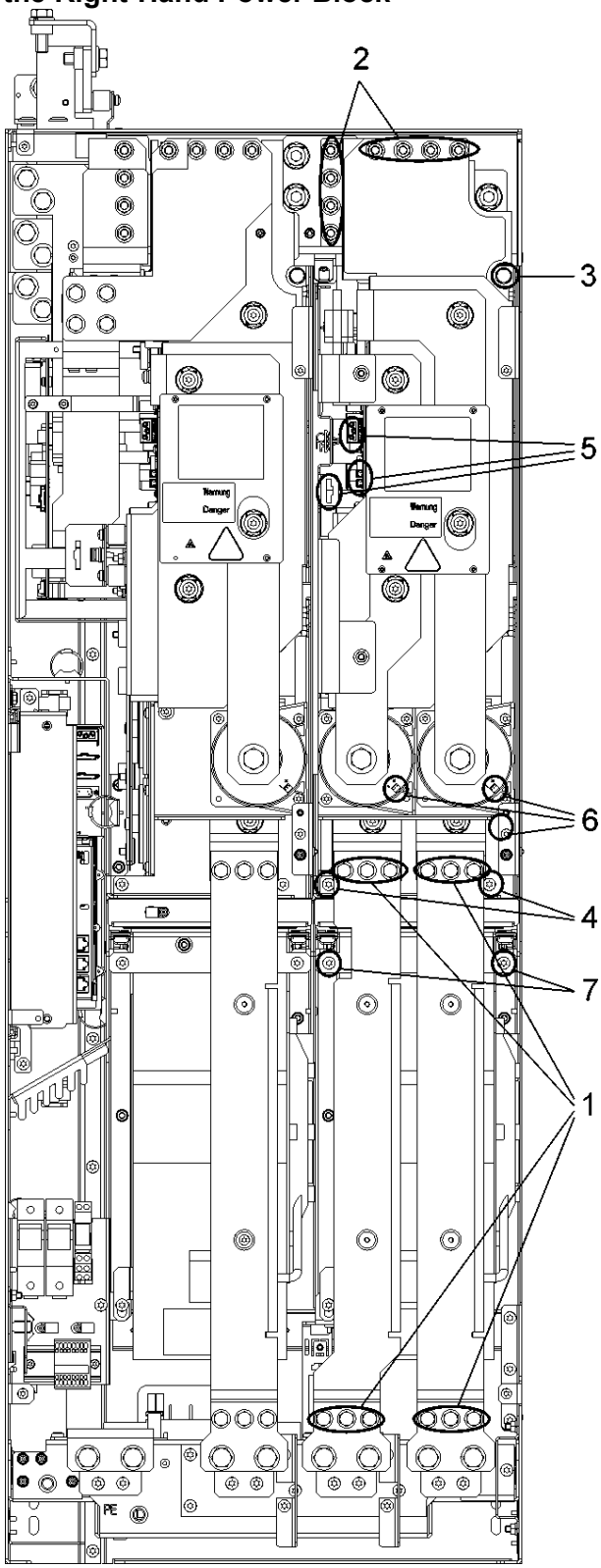


Fig. 11-5 Replacing the power block (type HX) (right-hand power block)

Preparatory Steps

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access to the power block.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-5.

1. Remove the busbars (12 screws).
2. Unscrew the connection to the DC link (8 nuts).
3. Remove the retaining screw at the top (1 screw).
4. Remove the retaining screws at the bottom (2 screws).
5. Disconnect the plugs for the fiber optic cables and signal cables (3 plugs).
6. Remove the connection for the current transformer and associated PE connection (2 plug).
7. Unscrew the two retaining screws for the fan and attach the installation device for the power block at this position.

You can now remove the power block.

CAUTION

When removing the power block, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.5 Replacing the Power Block (Type JX)

Replacing the Left-Hand Power Block

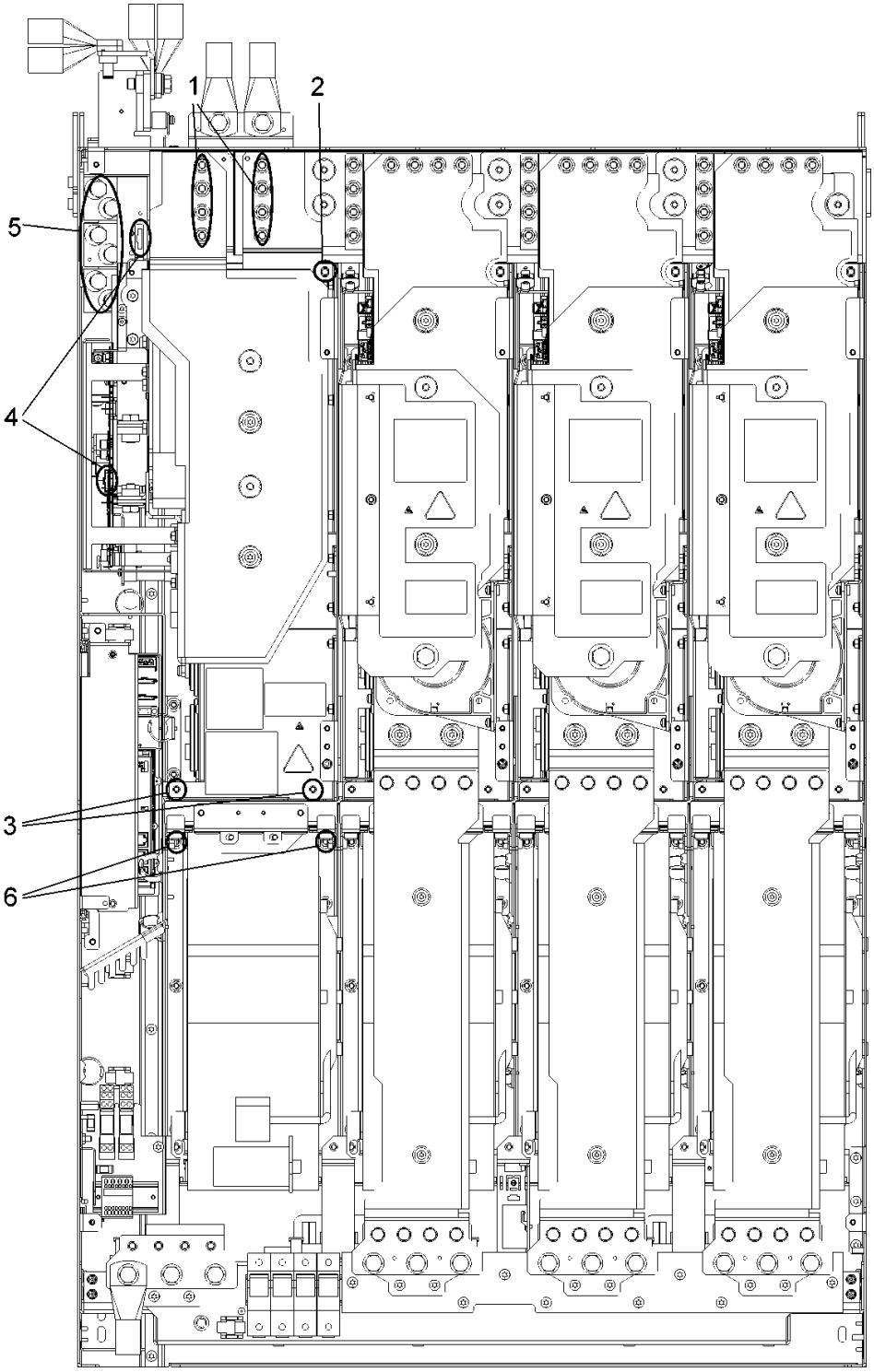


Fig. 11-6 Replacing the power block (type JX) (left-hand power block)

Preparatory Steps

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access to the power block.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-6.

1. Unscrew the connection to the DC link (8 nuts).
2. Remove the retaining screw at the top (1 screw).
3. Remove the retaining screws at the bottom (2 screws).
4. Disconnect the plugs for the fiber optic cables and signal cables (2 plugs).
5. Remove the power connections (6 screws).
6. Unscrew the two retaining screws for the fan and attach the installation device for the power block at this position.

You can now remove the power block.

CAUTION

When removing the power block, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

Replacing the Right-Hand Power Block

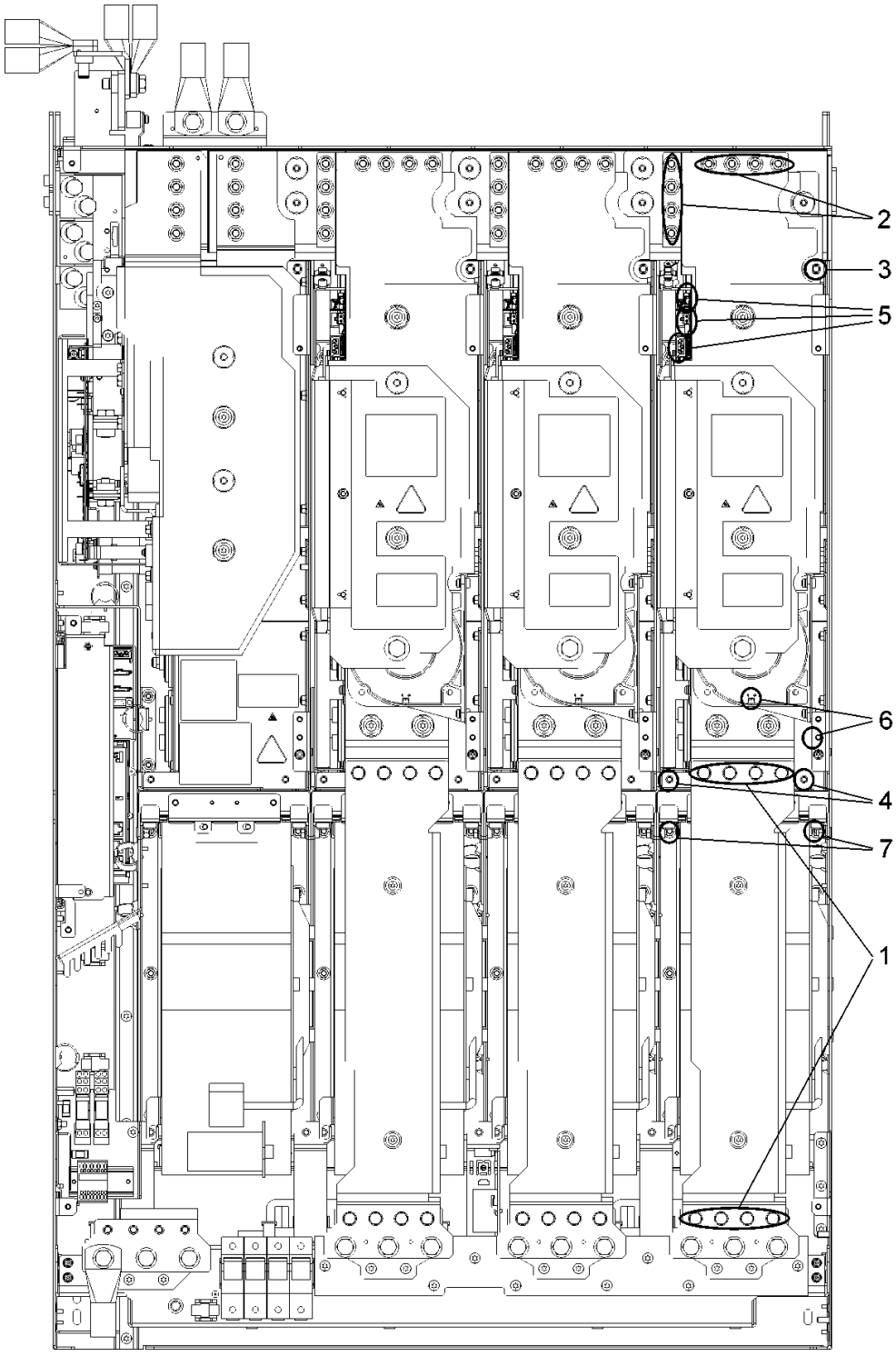


Fig. 11-7 Replacing the power block (type JX) (right-hand power block)

Preparatory Steps

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access to the power block.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-7.

1. Remove the busbar (8 screws).
2. Unscrew the connection to the DC link (8 nuts).
3. Remove the retaining screw at the top (1 screw).
4. Remove the retaining screws at the bottom (2 screws).
5. Disconnect the plugs for the fiber optic cables and signal cables (2 plugs).
6. Remove the connection for the current transformer and associated PE connection (1 plug).
7. Unscrew the two retaining screws for the fan and attach the installation device for the power block at this position.

You can now remove the power block.

CAUTION

When removing the power block, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.6 Replacing the Control Interface Board (Type FX)

Replacing the Control Interface Board

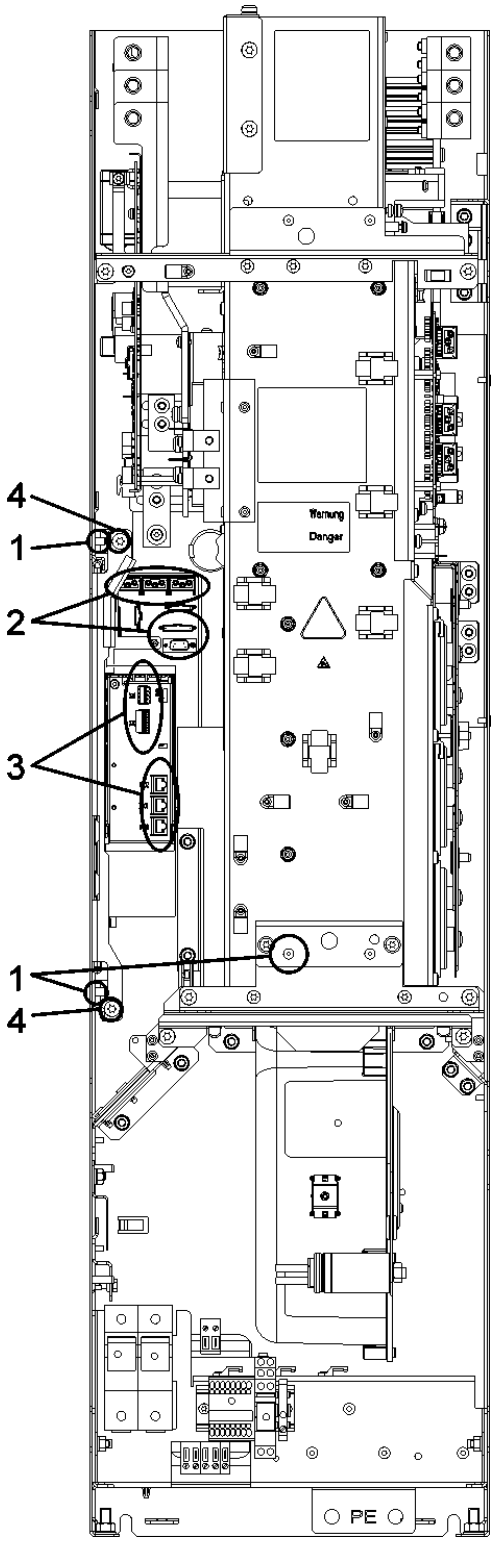


Fig. 11-8 Replacing the control interface board (type FX)

Preparatory Steps

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access to the fan.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-8.

1. Remove the CU320 mounts (1 screw and 2 nuts). If necessary, remove the PROFIBUS plug and connection to the operator panel (-X140 on the CU320) and remove the CU320.
2. Disconnect the plugs for the fiber optic cables and signal cables (5 plugs).
3. Remove the DRIVE-CLiQ cables and connections to the CU320 (5 plugs).
4. Remove the retaining screws for the electronics slide-in unit (2 screws). When removing the electronics slide-in unit, you have to disconnect 5 further plugs one after the other (2 at the top, 3 below).

CAUTION

When removing the fan, ensure that you do not damage any signal cables.

5. The control interface board can then be removed from the electronics slide-in unit.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.7 Replacing the Control Interface Board (Type GX)

Replacing the Control Interface Board

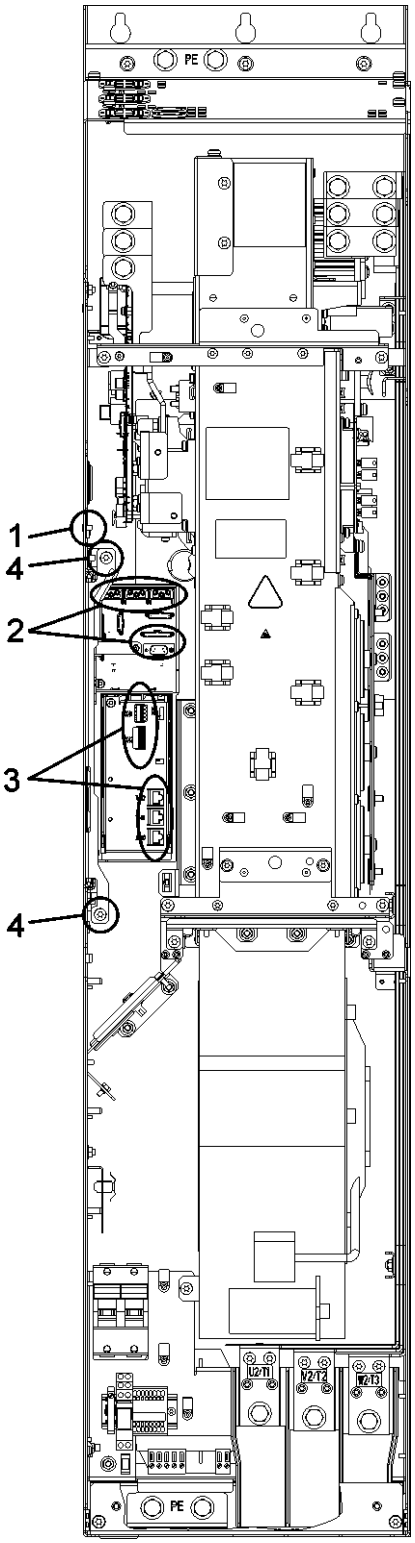


Fig. 11-9 Replacing the control interface board (type GX)

Preparatory Steps

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access to the fan.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-9.

1. Remove the CU320 mount (1 nut). If necessary, remove the PROFIBUS plug and connection to the operator panel (-X140 on the CU320) and carefully remove the CU320.
2. Disconnect the plugs for the fiber optic cables and signal cables (5 plugs).
3. Remove the DRIVE-CLiQ cables and connections to the CU320 (5 plugs).
4. Remove the retaining screws for the electronics slide-in unit (2 screws). When removing the electronics slide-in unit, you have to disconnect 5 further plugs one after the other (2 at the top, 3 below).

CAUTION

When removing the fan, ensure that you do not damage any signal cables.

5. The control interface board can then be removed from the electronics slide-in unit.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.8 Replacing the Control Interface Board (Type HX)

Replacing the Control Interface Board

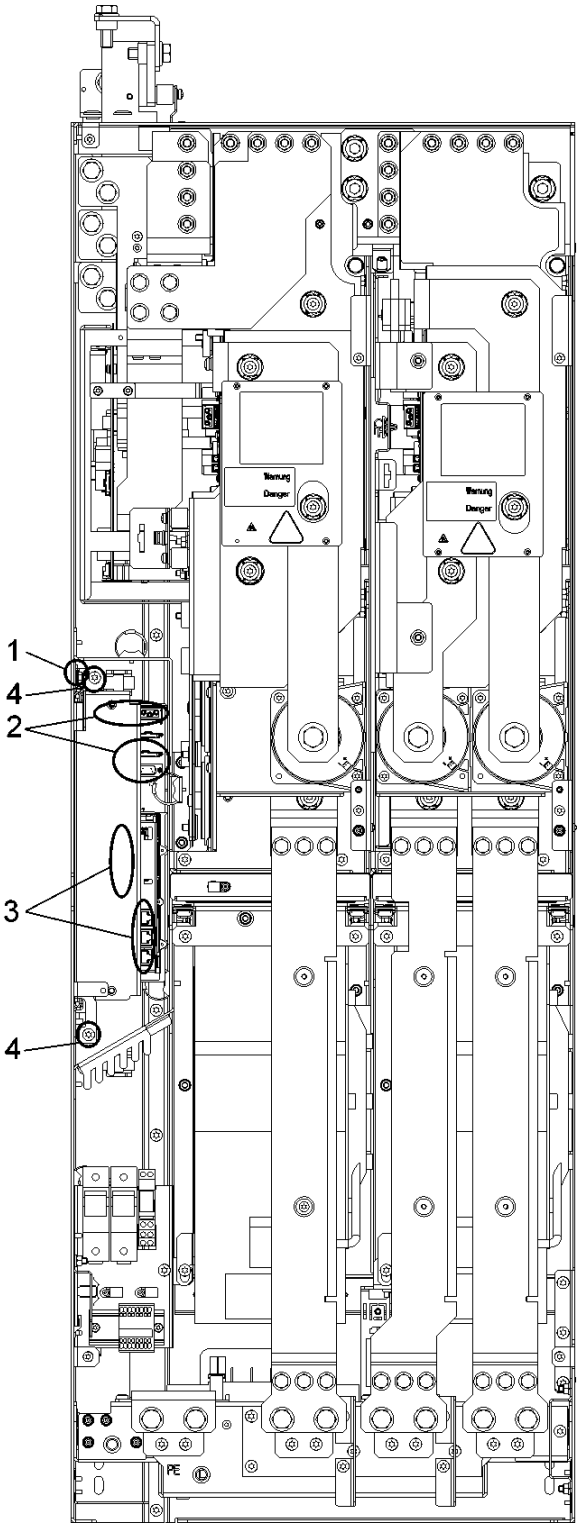


Fig. 11-10 Replacing the control interface board (type HX)

Preparatory Steps

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access to the fan.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-10.

1. Remove the CU320 mount (1 nut). If necessary, remove the PROFIBUS plug and connection to the operator panel (-X140 on the CU320) and carefully remove the CU320.
2. Disconnect the plugs for the fiber optic cables and signal cables (5 plugs).
3. Remove the DRIVE-CLiQ cables and connections to the CU320 (5 plugs).
4. Remove the retaining screws for the electronics slide-in unit (2 screws). When removing the electronics slide-in unit, you have to disconnect 5 further plugs one after the other (2 at the top, 3 below).

   CAUTION

   When removing the fan, ensure that you do not damage any signal cables.

5. The control interface board can then be removed from the electronics slide-in unit.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.9 Replacing the Control Interface Board (Type JX)

Replacing the Control Interface Board

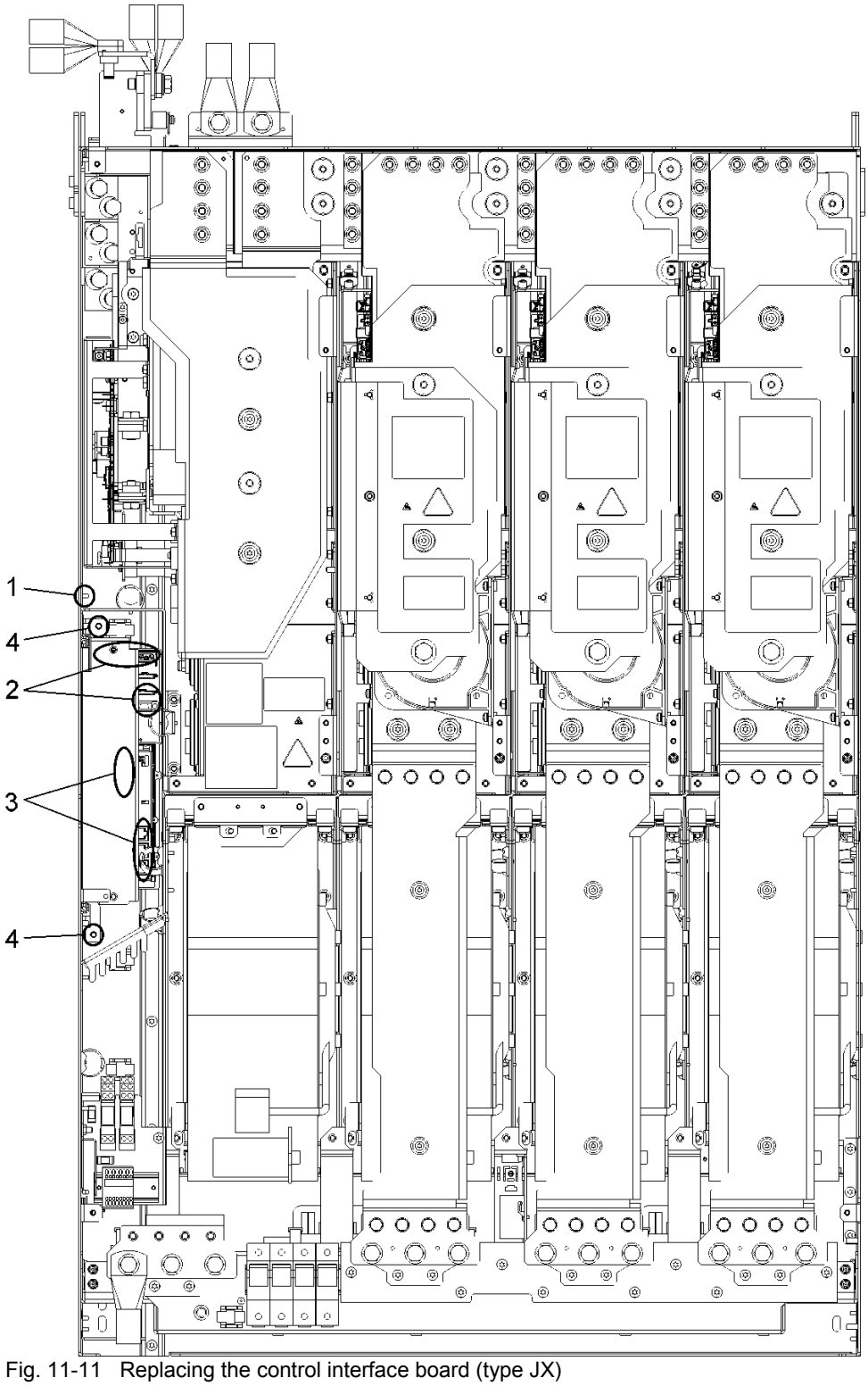


Fig. 11-11 Replacing the control interface board (type JX)

Preparatory Steps

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access to the fan.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-11.

1. Remove the CU320 mount (1 nut). If necessary, remove the PROFIBUS plug and connection to the operator panel (-X140 on the CU320) and carefully remove the CU320.
2. Disconnect the plugs for the fiber optic cables and signal cables (5 plugs).
3. Remove the DRIVE-CLiQ cables and connections to the CU320 (5 plugs).
4. Remove the retaining screws for the electronics slide-in unit (2 screws). When removing the electronics slide-in unit, you have to disconnect 5 further plugs one after the other (2 at the top, 3 below).

   CAUTION

   When removing the fan, ensure that you do not damage any signal cables.

5. The control interface board can then be removed from the electronics slide-in unit.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.10 Replacing the Fan (Type FX)

Replacing the Fan

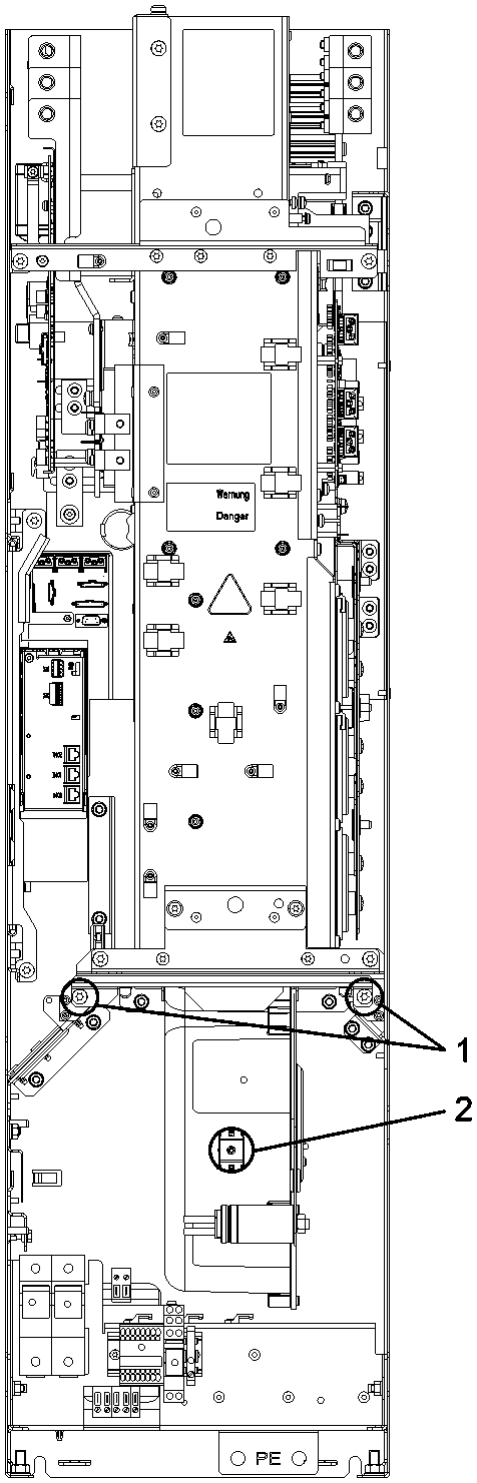


Fig. 11-12 Replacing the fan (type FX)

Description

The average service life of the device fans is 50,000 hours. In practice, however, the service life depends on other variables, including ambient temperature and the degree of cabinet protection and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the cabinet unit is available.

Preparatory Steps

- Disconnect the cabinet unit from the power supply.
- Open the cabinet door.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-12.

1. Remove the retaining screws for the fan (2 screws).
2. Disconnect the supply cables (1 x "L", 1 x "N").

You can now carefully remove the fan.

CAUTION

When removing the fan, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.11 Replacing the Fan (Type GX)

Replacing the Fan

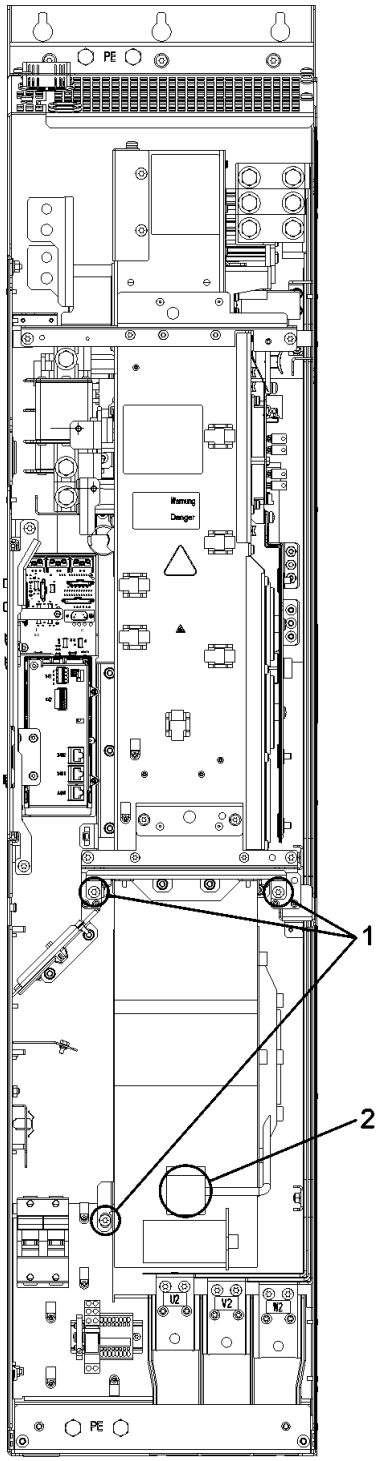


Fig. 11-13 Replacing the fan (type GX)

Description

The average service life of the device fans is 50,000 hours. In practice, however, the service life depends on other variables, including ambient temperature and the degree of cabinet protection and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the cabinet unit is available.

Preparatory Steps

- Disconnect the cabinet unit from the power supply.
- Open the cabinet door.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-13.

1. Remove the retaining screws for the fan (3 screws).
2. Disconnect the supply cables (1 x "L", 1 x "N").

You can now carefully remove the fan.

CAUTION

When removing the fan, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.12 Replacing the Fan (Type HX)

Replacing the Fan (Left-Hand Power Block)

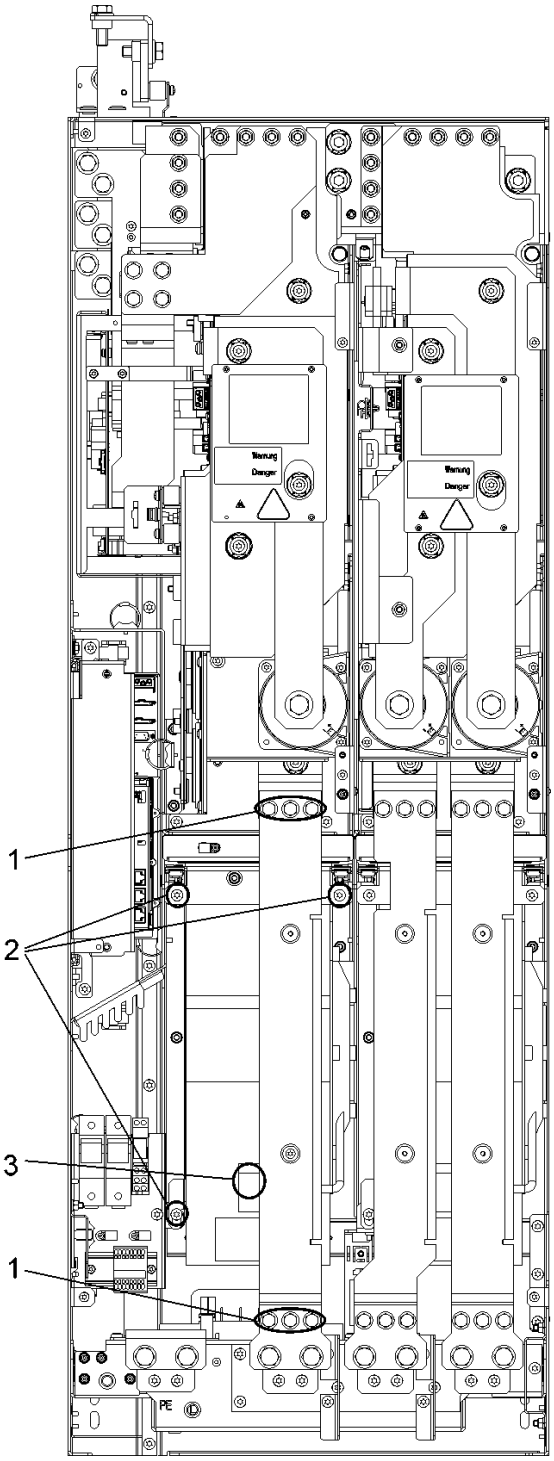


Fig. 11-14 Replacing the fan (type HX) (left-hand power block)

Description

The average service life of the device fans is 50,000 hours. In practice, however, the service life depends on other variables, including ambient temperature and the degree of cabinet protection and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the cabinet unit is available.

Preparatory Steps

- Disconnect the cabinet unit from the power supply.
- Open the cabinet door.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-14.

1. Remove the copper bars (6 screws).
2. Remove the retaining screws for the fan (3 screws).
3. Disconnect the supply cables (1 x "L", 1 x "N").

You can now carefully remove the fan.

CAUTION

When removing the fan, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

Replacing the Fan (Right-Hand Power Block)

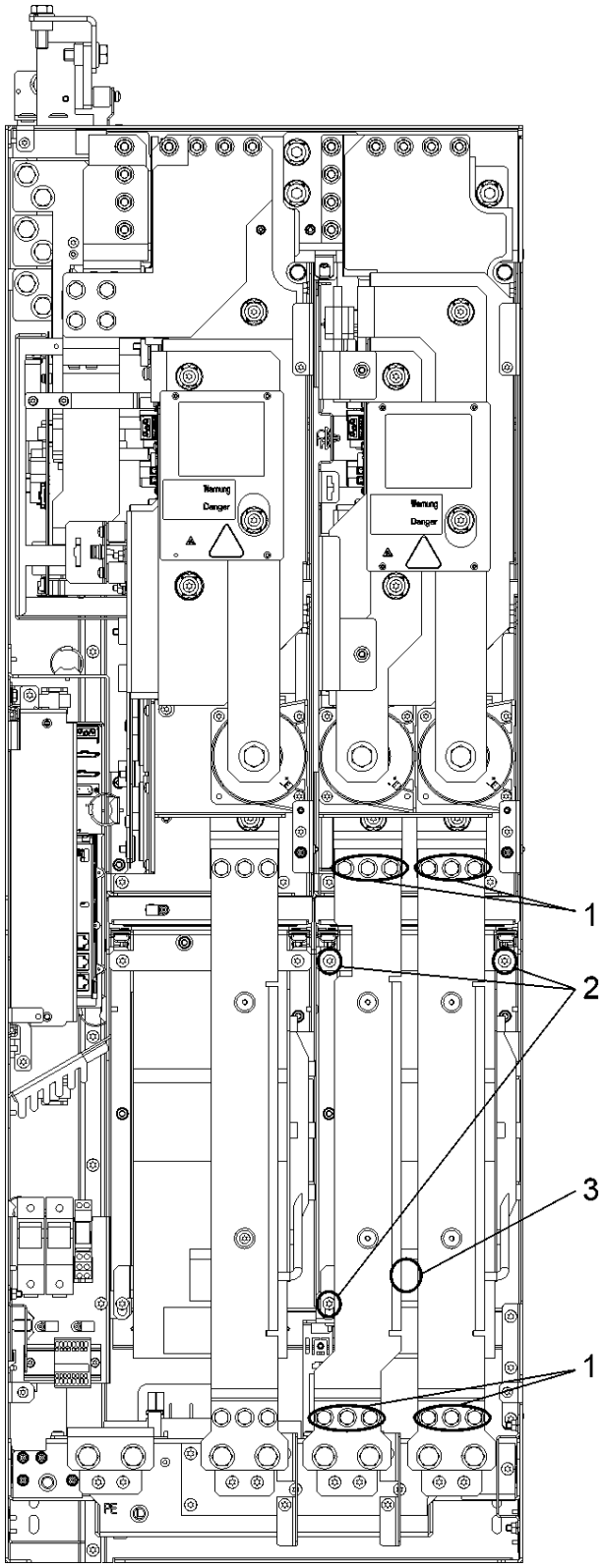


Fig. 11-15 Replacing the fan (type HX) (right-hand power block)

Description

The average service life of the device fans is 50,000 hours. In practice, however, the service life depends on other variables, including ambient temperature and the degree of cabinet protection and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the cabinet unit is available.

Preparatory Steps

- Disconnect the cabinet unit from the power supply.
- Open the cabinet door.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-15.

1. Remove the copper bars (12 screws).
2. Remove the retaining screws for the fan (3 screws).
3. Disconnect the supply cables (1 x "L", 1 x "N").

You can now carefully remove the fan.

CAUTION

When removing the fan, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.13 Replacing the Fan (Type JX)

Replacing the Fan (Left-Hand Power Block)

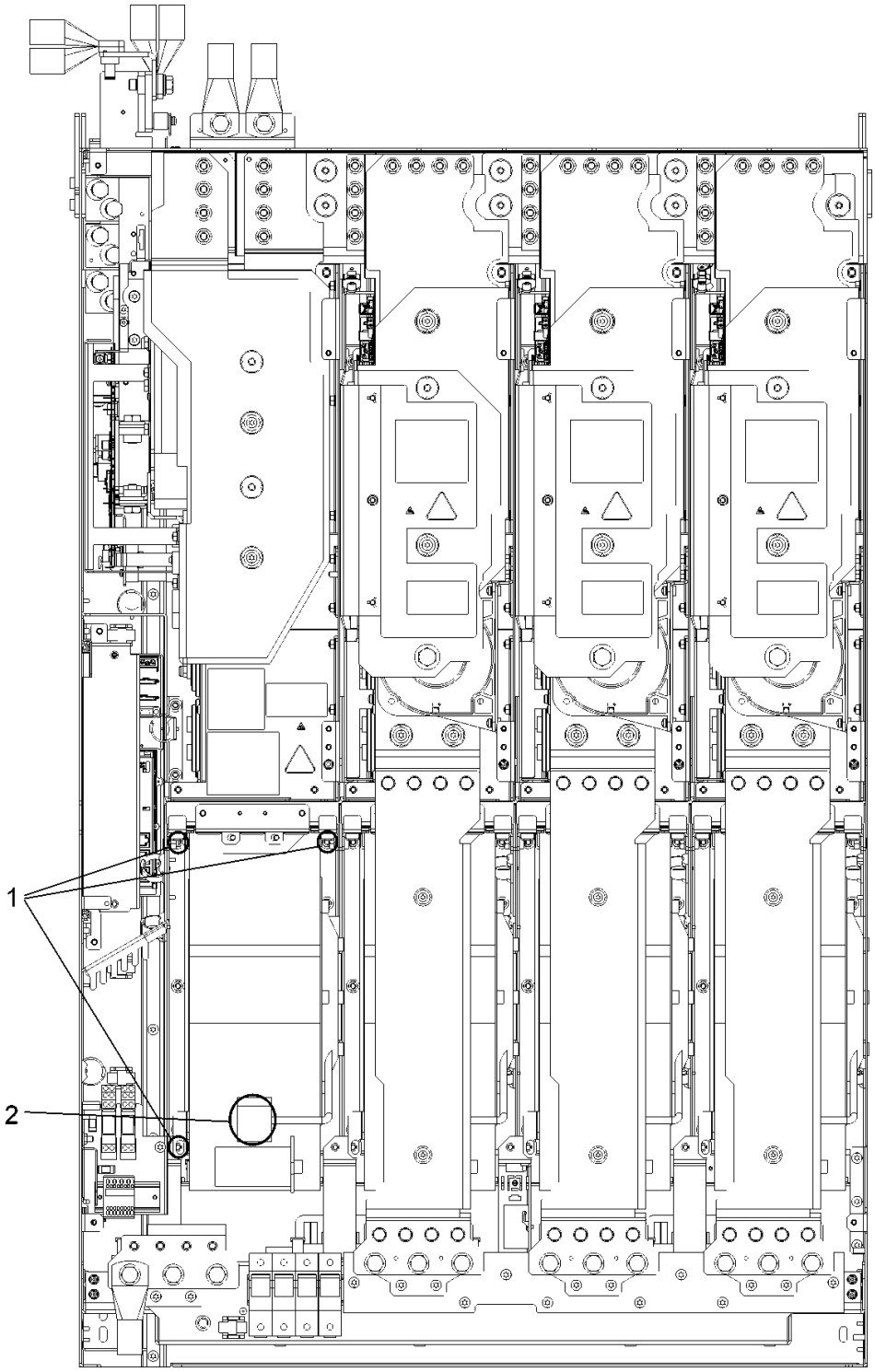


Fig. 11-16 Replacing the fan (type JX) (left-hand power block)

Description

The average service life of the device fans is 50,000 hours. In practice, however, the service life depends on other variables, including ambient temperature and the degree of cabinet protection and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the cabinet unit is available.

Preparatory Steps

- Disconnect the cabinet unit from the power supply.
- Open the cabinet door.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-16.

1. Remove the copper bars (6 screws).
2. Remove the retaining screws for the fan (3 screws).
3. Disconnect the supply cables (1 x "L", 1 x "N").

You can now carefully remove the fan.

CAUTION

When removing the fan, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

Replacing the Fan (Right-Hand Power Block)

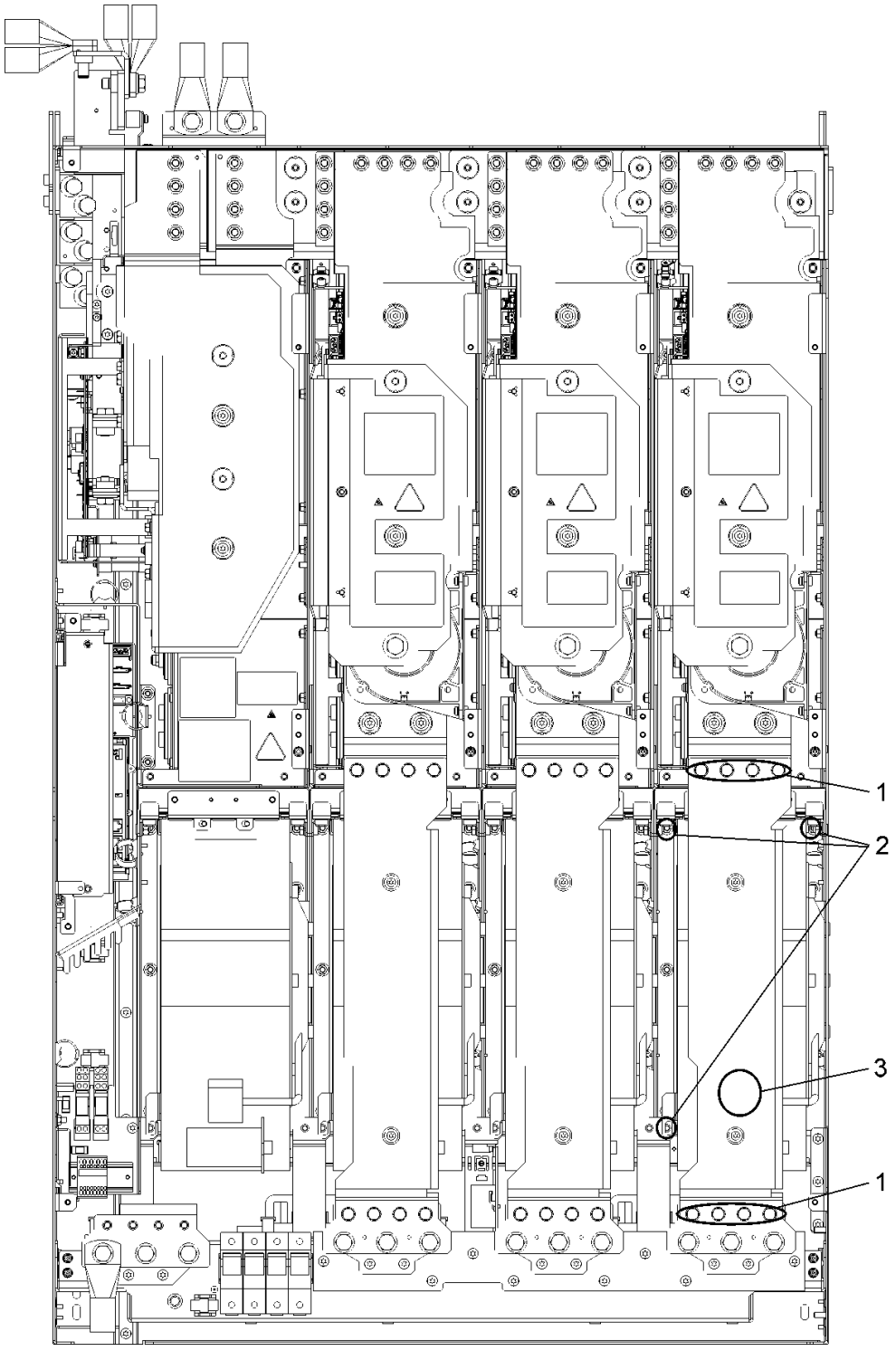


Fig. 11-17 Replacing the fan (type JX) (right-hand power block)

Description

The average service life of the device fans is 50,000 hours. In practice, however, the service life depends on other variables, including ambient temperature and the degree of cabinet protection and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the cabinet unit is available.

Preparatory Steps

- Disconnect the cabinet unit from the power supply.
- Open the cabinet door.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-17.

1. Remove the copper bars (8 screws).
2. Remove the retaining screws for the fan (3 screws).
3. Disconnect the supply cables (1 x "L", 1 x "N").

You can now carefully remove the fan.

CAUTION

When removing the fan, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.14 Replacing the Fan Fuses (-U1-F10/-U1-F11)

The order numbers for replacement fan fuses can be found in the spare parts list.

WARNING

Make sure that the cause of the fault is found before the fuse is replaced.

11.4.15 Replacing the Fuses for the Auxiliary Power Supply (-A1-F11/-A1-F12)

The order numbers for replacing auxiliary power supply fuses that have blown can be found in the spare parts list in section 8 of the documentation folder.

WARNING

You must carry out the following:

- Disconnect the auxiliary power supply.
- Identify the cause of the fault.
- Replace the fuse.

11.4.16 Replacing Fuse -A1-F21

1. Open the cabinet.
2. Remove the defective fuse.
3. Fit the replacement fuse and close the fuse holder.
4. Close the cabinet.

The order numbers for replacing fuses that have blown can be found in the spare parts list.

WARNING

You must carry out the following:

- Disconnect the auxiliary power supply.
- Identify the cause of the fault.
- Replace the fuse.

11.4.17 Replacing the Cabinet Operator Panel

1. Switch off the main circuit-breaker.
2. Open the cabinet.
3. Disconnect the power supply and communications line on the operator panel.
4. Release the fastenings on the operator panel.
5. Remove the operator panel.
6. Install the new operator panel.
7. Carry out any other work by reversing the sequence.

11.4.18 Replacing the Backup Battery of the Cabinet Operator Panel

Table 11-2 Technical specifications for the backup battery

Type	CR2032 3V lithium battery
Manufacturer	Maxell, Sony, Panasonic
Rated capacity	220 mAh
Maximum permissible charging current	10 mA (restricted to <2 mA in operator panel)
Self-discharge at 20°C	1 %/year
Service life (in backup mode)	> 1 year at 70°C; >1.5 years at 20 °C
Service life (in operation)	> 2 years

Replacing the Backup Battery

1. Switch off the main circuit-breaker.
2. Open the cabinet.
3. Disconnect the 24 V DC power supply and communications line on the operator panel.
4. Open the cover of the battery compartment.
5. Remove the old battery.
6. Insert the new battery.
7. Close the cover of the battery compartment.
8. Reconnect the 24 V DC power supply and communications line.
9. Close the cabinet.

WARNING

To ensure that no data is lost when you replace the battery, you must replace the battery within one minute.

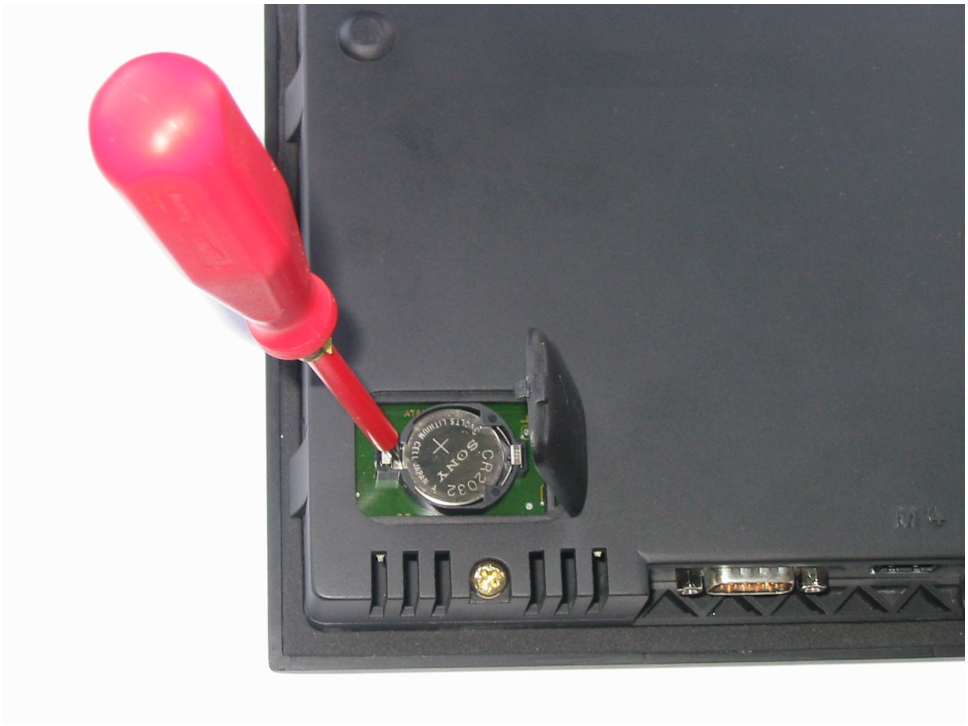


Fig. 11-18 Replacing the backup battery in the cabinet operator panel

11.5 Reforming the DC Link Capacitors

Description

If the cabinet unit is kept in storage for more than 2 years, the DC link capacitors have to be reformed. If this is not carried out, the cabinet may be damaged when the supply voltage is switched on.

If the cabinet is commissioned within two years of its date of manufacture, the DC link capacitors do not need to be reformed. The date of manufacture is indicated in the serial number on the type plate (see "Device Overview").

NOTE

It is important that the period of storage is calculated as of the date of manufacture and not as of the delivery date.

Procedure

The DC link capacitors are reformed by applying the rated voltage without load for at least 30 minutes at room temperature.

- Operation via PROFIBUS:
  - Set bit 3 of control word 1 (operation enable) permanently to "0".
  - Switch on the converter by means of an ON signal (bit 0 of the control word); all the other bits must be set in such a way that the converter can be operated.
  - Once the waiting time has elapsed, switch off the converter and restore the original PROFIBUS setting.
- Operation via terminal block:
  - Set p0852 to "0" (factory setting is "1").
  - Switch on the converter (via digital input 0 on the customer terminal block).
  - Once the waiting time has elapsed, switch off the converter and restore the original setting for p0852.

NOTE

Reforming cannot be carried out in LOCAL mode via the AOP30.

11.6 Messages after replacing DRIVE-CLiQ components

After DRIVE-CLiQ components are replaced (Control Interface Board, TM31, SMCxx) when service is required, generally, after power-up, a message is not output.

The reason for this is that an identical component is detected and accepted as spare part when running-up. If, unexpectedly, a fault message of the "topology fault" category is displayed, then when replacing a component, one of the following faults/errors should have occurred:

- A Control Interface Board with different firmware data was installed.
- When connecting-up DRIVE-CLiQ cables, connections were interchanged.

11.7 Upgrading the Cabinet Unit Firmware

When you upgrade the cabinet unit firmware (by installing a new CompactFlash Card with a new firmware version, for example), you may also have to upgrade the firmware for the components in the cabinet unit.

When you implement new firmware on the CompactFlash card, the firmware for the CU320 is upgraded automatically when you install it and switch it on.

The cabinet unit components (power section, customer terminal block, and optional SMC30) are supplied with the firmware by means of the procedure described below.

The firmware versions for the individual components can be read in the following parameters:

- r0128 – Firmware version of the power module
- r0148 – Firmware version of the sensor module (SMC30)
- r0158 – Firmware version of the customer terminal block (TM31)

NOTE

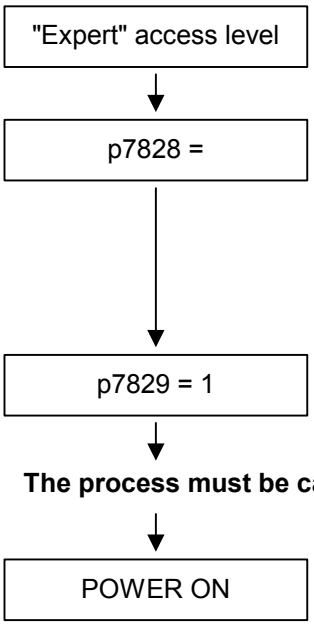
The power supply to the components must not be interrupted while the firmware is being upgraded.

CAUTION

New firmware should only be installed if there is a problem with the cabinet unit.

Problems with the cabinet unit cannot be ruled out after the firmware has been upgraded.

Upgrading the Firmware for the Cabinet Unit Components



Setting the "Expert" on the operator panel
<Key pushbutton> - <Access level> - Set "Expert" and confirm (enter activation code "47")

Select the number of the DRIVE-CLiQ node

Configuration:	without option G61	with option G61
Node	Number	Number
Power Module (-U1)	2	2
TM31 (-A60)	3	3
2nd TM31 (-A61)	--	4
SMC30 (option K50)	5	6

Starting the firmware update
The process takes a few minutes and is successfully complete when p7829 automatically switches to "0".

The process must be carried out consecutively for each DRIVE-CLiQ node.

Switching the power on
To activate the firmware update, switch the device off and then back on.

Fault during update
Fault F1005 (with a fault value) indicates that the firmware update was not successful.

Fig. 11-19 Upgrading the firmware for the cabinet unit components

NOTE

Once the firmware has been upgraded, the firmware for the operator panel must also be upgraded.

For the following cabinet units, the numbers of the DRIVE-CLiQ devices have changed with respect to the previous representation.

- for 3-ph. 380 V – 480 V AC:
  6SL3710-2GE41-1AA0, 6SL3710-2GE41-4AA0, 6SL3710-2GE41-6AA0
- for 3-ph. 500 V – 600 V AC:
  6SL3710-2GF38-6AA0, 6SL3710-2GF41-1AA0, 6SL3710-2GF41-4AA0
- for 3-ph. 660 V – 690 V AC:
  6SL3710-2GH41-1AA0, 6SL3710-2GH41-4AA0, 6SL3710-2GH41-5AA0

Table 11-3 Numbers of the DRIVE-CLiQ nodes

Configuration:	without option G61	with option G61
Nodes	Number	Number
Power Module (-U1), lefthand sub-cabinet	2	2
Power Module (-U1), righthand sub-cabinet	3	3
TM31 (-A60)	4	4
2. TM31 (-A61)		5
SMC30 (option K50)	6	7

11.8 Loading the new operator panel firmware and database from the PC

Description

You have to load the database for the operator panel each time you require a language other than that stored in the operator panel, or if the firmware of the cabinet unit has been upgraded to enhance its functionality or rectify problems.

Firmware may need to be loaded to the AOP if the AOP has been upgraded to enhance its functionality or rectify problems.

The load program LOAD_AOP30 and the database files can be found on the CD.

Procedure for Loading the Database

1. Establish the RS232 connection from the PC to the AOP30.
2. Provide the supply voltage (24 V DC).
3. Start the LOAD_AOP30 program on the PC.
4. Choose the PC interface (COM1, COM2).
5. Depending on the language you require, choose a file (e.g. AOP30_DB.V02.30.20.E.D.CBIN) and open it to start loading the database.
6. Once this is complete, "Database loaded" is displayed on the AOP30.
7. Switch the power on (switch the power supply off and then back on).

Procedure for Loading Firmware and the Database

1. Establish the RS232 connection from the PC to the AOP30.
2. Provide the supply voltage (24 V DC).
3. Start the LOAD_AOP30 program on the PC.
4. Choose the PC interface (COM1, COM2).
5. Choose and open the firmware (AOP30.H86).
6. Follow the instructions in the status window of the program and connect the power supply for the AOP30 while pressing the red key (O).
7. The load procedure is started automatically.
8. If a current database has not been loaded, the system switches to the "loading database" screen once the loading procedure has finished
9. Depending on the language you require, choose a file (e.g. AOP30_DB.V02.30.20.E.D.CBIN) and open it to start loading the database.
10. Once this is complete, "Database loaded" is displayed on the AOP30.
11. Switch the power on (switch the power supply off and then back on).

■

Technical Data

12

12.1 Chapter Content

This chapter provides information on the following:

- General and specific technical data for the SINAMICS G150 cabinet units
- Information on restrictions that apply when the cabinets are used in unfavorable ambient conditions (derating)

12.2 General Data

Table 12-1 General technical data

Electrical specifications			
Line frequency	47 Hz to 63 Hz		
Output frequency	0 Hz to 300 Hz		
Power factor Fundamental mode Total	 ≥ 0.98 0,93 to 0.96		
Converter efficiency	> 98 %		
Switching at input	Once every 3 minutes		
Mechanical data			
Degree of protection	IP 20 (higher degrees of protection up to IP 54 optional)		
Class of protection	To EN 50178, Part 1		
Cooling method	Forced air cooling		
Sound pressure level	≤ 75 dB(A) at 50 Hz line frequency ≤ 78 dB(A) at 60 Hz line frequency		
Shock-hazard protection	BGV A2		
Cabinet system	Rittal TS 8, doors with double-barb lock		
Paint finish	RAL 7035 (indoor requirements)		
Compliance with standards			
Standards	EN 60 146-1, EN 61 800-2, EN 61 800-3, EN 50 178, EN 60 204-1, EN 60 529		
CE marking	To EMC directive No. 89/336/EC and low voltage directive No. 73/23/EC		
RI suppression	In accordance with EMC product standard for variable-speed drives (EN 61 800-3); category C3 (category C2 optional (L00)) [1)]		
Ambient conditions			
	Operation	Storage	Transport
Ambient temperatures	0 °C to +40 °C Up to + 50 °C with derating	-25°C to +55°C	-25 °C to +70 °C Above –40 °C for 24 hours
Humidity range (non-condensing) Corresponds to class	5 % to 95 % 3K3 to IEC 60 721-3-3	5 % to 95 % 1K4 to IEC 60 721-3-1	5 % to 95 % at 40 °C 2K3 to IEC 60 721-3-2
Site altitude	Up to 2000 m above sea level without derating, > 2000 m above sea level with derating, see Section 12.2.1		
Strain resistance			
Vibratory load: Deflection Acceleration Corresponds to class	 0.075 mm at 10 Hz to 58 Hz 10 m/s² at > 58 Hz to 200 Hz -	 1.5 mm at 5 Hz to 9 Hz 5 m/s² at > 9 Hz to 200 Hz 1M2 to IEC 60 721-3-1	 3.1 mm at 5 Hz to 9 Hz 10 m/s² at > 9 Hz to 200 Hz 2M2 to IEC 60 721-3-2
Shock load: Acceleration Corresponds to class	 100 m/s² at 11 ms 3M4 to IEC 60 721-3-3	 40 m/s² at 22 ms 1M2 to IEC 60 721-3-1	 100 m/s² at 11 ms 2M2 to IEC 60 721-3-2

[1)] applies to cable lengths up to 100 m.

12.2.1 Derating Data

Current Derating as a Function of the Site Altitude and Ambient Temperature

If the cabinet units are operated at a site altitude >2000 m above sea level, the maximum permissible output current can be calculated using the following tables. The site altitude and ambient temperature are compensated here. The degree of protection selected for the cabinet units must also be taken into account.

Table 12-2 Current derating as a function of the ambient temperature (inlet air temperature at the air inlet of the cabinet unit) and site altitude for cabinet units with degree of protection IP20 / IP21and IP23

Site altitude above sea level in m	Ambient temperature in °C						
	20	25	30	35	40	45	50
0 to 2000						95,0%	87,0%
Up to 2500		100%			96,3%	91,4%	83,7%
Up to 3000				96,2%	92,5%	87,9%	80,5%
Up to 3500			96,7%	92,3%	88,8%	84,3%	77,3%
Up to 4000		97,8%	92,7%	88,4%	85,0%	80,8%	74,0%

Table 12-3 Current derating as a function of the ambient temperature (inlet temperature at the air inlet for the cabinet unit) and site altitude for cabinet units with degree of protection IP54

Site altitude above sea level in m	Ambient temperature in °C						
	20	25	30	35	40	45	50
0 to 2000					95,0%	87,5%	80,0%
Up to 2500		100%		96,3%	91,4%	84,2%	77,0%
Up to 3000			96,2%	92,5%	87,9%	81,0%	74,1%
Up to 3500		96,7%	92,3%	88,8%	84,3%	77,7%	71,1%
Up to 4000	97,8%	92,7%	88,4%	85,0%	80,8%	74,7%	68,0%

Voltage Derating as a Function of the Site Altitude

In addition to current derating, voltage derating must also be considered at site altitudes >2000 m above sea level.

Table 12-4 Voltage derating as a function of the site altitude (380 V – 480 V 3AC)

Site altitude above sea level in m	Rated converter input voltage					
	380 V	400 V	420 V	440 V	460 V	480 V
0 to 2000						
Up to 2250						96%
Up to 2500					98%	94%
Up to 2750		100%		98%	94%	90%
Up to 3000				95%	91%	88%
Up to 3250			97%	93%	89%	85%
Up to 3500		98%	93%	89%	85%	82%
Up to 3750		95%	91%	87%	83%	79%
Up to 4000	96%	92%	87%	83%	80%	76%

Table 12-5 Voltage derating as a function of the site altitude (500 V – 600 V 3AC)

Site altitude above sea level in m	Rated converter input voltage				
	500 V	525 V	550 V	575 V	600 V
0 to 2000					
Up to 2250					97%
Up to 2500		100%		98%	94%
Up to 2750			99%	95%	91%
Up to 3000			96%	92%	88%
Up to 3250		98%	93%	89%	85%
Up to 3500	99%	94%	90%	86%	83%
Up to 3750	96%	91%	87%	83%	80%
Up to 4000	92%	88%	84%	80%	77%

Table 12-6 Voltage derating as a function of the site altitude (660 V – 690 V 3AC)

Site altitude above sea level in m	Rated converter input voltage	
	660 V	690 V
0 to 2000	100%	
Up to 2250		96%
Up to 2500	98%	94%
Up to 2750	95%	90%
Up to 3000	92%	88%
Up to 3250	89%	85%
Up to 3500	85%	82%
Up to 3750	-	-
Up to 4000	-	-

Current Derating as a Function of the Pulse Frequency

When the pulse frequency is increased, the derating factor of the output current must be taken into account. This derating factor must be applied to the currents specified in the technical specifications in Section 12.3.

Table 12-7 Derating factor of the output current as a function of the pulse frequency for devices with a rated pulse frequency of 2 kHz

Order no. 6SL3710-...	Power [kW]	Output current at 2 kHz [A]	Derating factor at 4 kHz
Supply voltage: 380 – 480 V 3AC			
1GE32-1_A0	110	210	82 %
1GE32-6_A0	132	260	87 %
1GE33-1_A0	160	310	87 %
1GE33-8_A0	200	380	87 %
1GE35-0_A0	250	490	83 %

Table 12-8 Derating factor of the output current as a function of the pulse frequency for devices with a rated pulse frequency of 1.25 kHz

Order no. 6SL3710-...	Power [kW]	Output current at 1.25 kHz [A]	Derating factor at 2.5 kHz	Derating factor at 5 kHz
Supply voltage: 380 – 480 V 3AC				
1GE36-1_A0	315	605	72 %	60 %
1GE37-5_A0	400	745	72 %	60 %
1GE38-4_A0	450	840	79 %	60 %
1GE41-0_A0	560	985	87 %	60 %
2GE41-1AA0	630	1120	72 %	60 %
2GE41-4AA0	710	1380	72 %	60 %
2GE41-6AA0	900	1560	79 %	60 %
Supply voltage: 500 – 600 V 3AC				
1GF31-8_A0	110	175	87 %	60 %
1GF32-2_A0	132	215	87 %	60 %
1GF32-6_A0	160	260	88 %	60 %
1GF33-3_A0	200	330	82 %	55 %
1GF34-1_A0	250	410	82 %	55 %
1GF34-7_A0	315	465	87 %	55 %
1GF35-8_A0	400	575	85 %	55 %
1GF37-4_A0	500	735	79 %	55 %
1GF38-1_A0	560	810	72 %	55 %
2GF38-6AA0	630	860	87 %	55 %
2GF41-1AA0	710	1070	85 %	55 %
2GF41-4AA0	1000	1360	79 %	55 %

Order no. 6SL3710-...	Power [kW]	Output current at 1.25 kHz [A]	Derating factor at 2.5 kHz	Derating factor at 5 kHz
Supply voltage: 660 – 690 V 3AC				
1GH28-5_A0	75	85	89 %	60 %
1GH31-0_A0	90	100	88 %	60 %
1GH31-2_A0	110	120	88 %	60 %
1GH31-5_A0	132	150	84 %	55 %
1GH31-8_A0	160	175	87 %	60 %
1GH32-2_A0	200	215	87 %	60 %
1GH32-6_A0	250	260	88 %	60 %
1GH33-3_A0	315	330	82 %	55 %
1GH34-1_A0	400	410	82 %	55 %
1GH34-7_A0	450	465	87 %	55 %
1GH35-8_A0	560	575	85 %	55 %
1GH37-4_A0	710	735	79 %	55 %
1GH38-1_A0	800	810	72 %	55 %
2GH41-1AA0	1000	1070	85 %	55 %
2GH41-4AA0	1350	1360	79 %	55 %
2GH41-5AA0	1500	1500	72 %	55 %

12.2.2 Overload Capability

The drive converter cabinets are equipped with an overload reserve to deal with breakaway torques, for example.

In drives with overload requirements, the appropriate base load current must, therefore, be used as a basis for the required load.

The criterion for overload is that the drive is operated with its base load current before and after the overload occurs (a load duration of 300 s is used as a basis here).

Low overload

The base load current for low overload (I_L) is based on a load duty cycle of 110% for 60 s or 150% for 10 s.

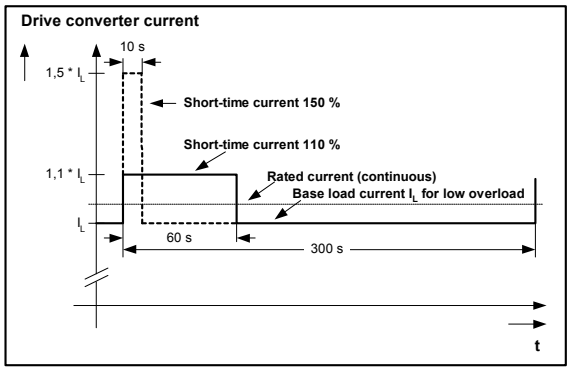


Fig. 12-1 Low overload

High Overload

The base load current for a high overload (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s.

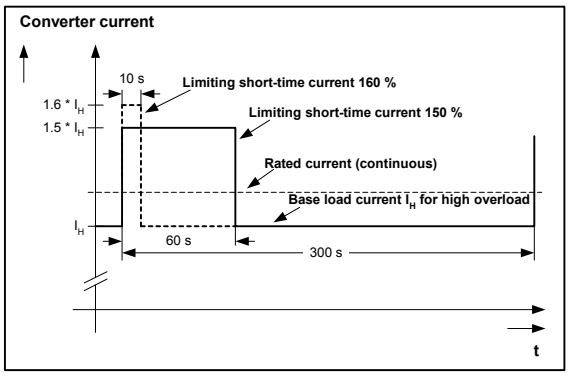


Fig. 12-2 High overload

12.3 Technical Data

NOTE

The current, voltage, and output values specified in the following tables are rated values.
The cables to the cabinet unit are protected with fuses with gL characteristic.
The connection cross-sections are calculated for three-core copper cables installed horizontally in free air at an ambient temperature of 30 °C (86 °F) (in accordance with DIN VDE 0298 Part 2 / Group 5) and the recommended line protection in accordance with DIN VDE 0100 Part 430.
AWG (American Wire Gauge for cross-sections < 120 mm²); MCM (Mille Circular Mil): American wire gauge for cross-sections > 120 mm².

12.3.1 Cabinet Unit Version A, 380 V – 480 V 3AC

Table 12-9 Version A, 380 V – 480 V 3AC, part 1

Category	Unit			
Order no. **6SL3710-**		**1GE32-1AA0**	**1GE32-6AA0**	**1GE33-1AA0**
Rated motor output At 400 V, 50 Hz At 460 V, 60 Hz	 kW hp	 110 150	 132 200	 160 250
Rated input voltage	V	3 AC 380 V to 480 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	239	294	348
Rated output current	A	210	260	310
Base load current I_L [2]	A	205	250	302
Base load current I_H [3]	A	178	233	277
Maximum output frequency [4]	Hz	160	160	160
Power loss	kW	2.9	3.8	4.4
Cooling air requirement	m³/s	0.17	0.23	0.36
Sound pressure level at 50/60 Hz	dB(A)	67/68	69/73	69/73
Line connection Recommended: DIN VDE AWG / MCM Maximum: DIN VDE AWG / MCM Fastening screw	 mm^2 mm^2 	 2 x 70 2 x (000) 4 x 240 4 x (600) M12 (2 holes)	 2 x 95 2 x (4/0) 4 x 240 4 x (600) M12 (2 holes)	 2 x 120 2 x (300) 4 x 240 4 x (600) M12 (2 holes)
Motor connection Recommended: DIN VDE AWG / MCM Maximum: DIN VDE AWG / MCM Fastening screw	 mm^2 mm^2 	 2 x 50 2 x (00) 2 x 150 2 x (400) M12 (2 holes)	 2 x 70 2 x (000) 2 x 150 2 x (400) M12 (2 holes)	 2 x 95 2 x (4/0) 2 x 150 2 x (400) M12 (2 holes)
PE conductor connection Fastening screw	 	 M12 (2 holes)	 M12 (2 holes)	 M12 (2 holes)
Approx. weight (standard version)	kg	320	320	390
Power block type		FX	FX	GX
Dimensions (standard version) (W x H x D)	 mm	 800 x 2000 x 600	 800 x 2000 x 600	 800 x 2000 x 600
Recommended protection Conductor protection (with option L26) Rated current Size to DIN 43 620-1 Cond./semi-cond. protection (without option L26) Rated current Size to DIN 43 620-1	 A A 	 3NA3 252 315 2 3NE1 230-2 315 1	 3NA3 254 355 2 3NE1 331-2 350 2	 3NA3 365 500 3 3NE1 334-2 500 2

1) The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

2) The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

3) The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

4) Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-10 Version A, 380 V – 480 V 3AC, part 2

Category	Unit			
Order no. **6SL3710-**		**1GE33-8AA0**	**1GE35-0AA0**	**1GE36-1AA0**
Rated motor output At 400 V, 50 Hz At 460 V, 60 Hz	 kW hp	 200 300	 250 400	 315 500
Rated input voltage	V	3 AC 380 V to 480 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	405	519	639
Rated output current	A	380	490	605
Base load current I_L [2]	A	370	477	590
Base load current I_H [3]	A	340	438	460
Maximum output frequency [4]	Hz	160	160	100
Power loss	kW	5.3	6.4	8.2
Cooling air requirement	m³/s	0.36	0.36	0.78
Sound pressure level at 50/60 Hz	dB(A)	69/73	69/73	70/73
Line connection Recommended: DIN VDE AWG / MCM Maximum: DIN VDE AWG / MCM Fastening screw	 mm^2 mm^2 	 2 x 120 2 x (300) 4 x 240 4 x (600) M12 (2 holes)	 2 x 185 2 x (500) 4 x 240 4 x (600) M12 (2 holes)	 2 x 240 2 x (600) 4 x 240 4 x (600) M12 (2 holes)
Motor connection Recommended: DIN VDE AWG / MCM Maximum: DIN VDE AWG / MCM Fastening screw	 mm^2 mm^2 	 2 x 95 2 x (4/0) 2 x 150 2 x (400) M12 (2 holes)	 2 x 150 2 x (400) 2 x 240 2 x (600) M12 (2 holes)	 2 x 185 2 x (500) 4 x 240 4 x (600) M12 (2 holes)
PE conductor connection Fastening screw	 	 M12 (2 holes)	 M12 (2 holes)	 M12 (2 holes)
Approx. weight (standard version)	kg	480	480	860
Power block type		GX	GX	HX
Dimensions (standard version) (W x H x D)	 mm	 1000 x 2000 x 600	 1000 x 2000 x 600	 1200 x 2000 x 600
Recommended protection Conductor protection (with option L26) Rated current Size to DIN 43 620-1 Cond./semi-cond. protection (without option L26) Rated current Size to DIN 43 620-1	 A A 	 3NA3 365 500 3 3NE1 334-2 500 2	 3NA3 372 630 3 3NE1 436-2 630 3	 3NA3 475 800 4 3NE1 438-2 800 3

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-11 Version A, 380 V – 480 V 3AC, part 3

Category	Unit			
Order no. **6SL3710-**		**1GE37-5AA0**	**1GE38-4AA0**	**1GE41-0AA0**
Rated motor output At 400 V, 50 Hz At 460 V, 60 Hz	 kW hp	 400 600	 450 700	 560 800
Rated input voltage	V	3 AC 380 V to 480 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	785	883	1034
Rated output current	A	745	840	985
Base load current I_L [2]	A	725	820	960
Base load current I_H [3]	A	570	700	860
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	9.6	10.1	14.4
Cooling air requirement	m³/s	0.78	0.78	1.48
Sound pressure level at 50/60 Hz	dB(A)	70/73	70/73	72/75
Line connection Recommended: DIN VDE AWG / MCM Maximum: DIN VDE AWG / MCM Fastening screw	 mm^2 mm^2 	 2 x 300 2 x (800) 4 x 240 4 x (600) M12 (2 holes)	 4 x 150 4 x (400) 8 x 240 8 x (600) M12 (4 holes)	 3 x 240 3 x (600) 8 x 240 8 x (600) M12 (4 holes)
Motor connection Recommended: DIN VDE AWG / MCM Maximum: DIN VDE AWG / MCM Fastening screw	 mm^2 mm^2 	 3 x 150 3 x (400) 4 x 240 4 x (600) M12 (2 holes)	 3 x 185 3 x (500) 4 x 240 4 x (600) M12 (2 holes)	 4 x 185 4 x (500) 6 x 240 6 x (600) M12 (3 holes)
PE conductor connection Fastening screw		M12 (10 holes)	M12 (16 holes)	M12 (18 holes)
Approx. weight (standard version)	kg	865	1075	1360
Power block type		HX	HX	JX
Dimensions (standard version) (W x H x D)	 mm	 1200 x 2000 x 600	 1200 x 2000 x 600	 1600 x 2000 x 600
Recommended protection Conductor protection (with option L26) Rated current Size to DIN 43 620-1 Cond./semi-cond. protection (without option L26) Rated current Size to DIN 43 620-1	 A A 	 3NA3 475 800 4 3NE1 448-2 850 3	 Circuit-breaker Circuit-breaker 	 Circuit-breaker Circuit-breaker

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-12 Version A, 380 V – 480 V 3AC, part 4

Category	Unit			
Order no. **6SL3710-**		**2GE41-1AA0**	**2GE41-4AA0**	**2GE41-6AA0**
Rated motor output At 400 V, 50 Hz At 460 V, 60 Hz	 kW hp	 630 900	 710 1000	 900 1250
Rated input voltage	V	3 AC 380 V to 480 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	1174	1444	1624
Rated output current	A	1120	1380	1560
Base load current I_L [2]	A	1092	1340	1516
Base load current I_H [3]	A	850	1054	1294
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	16.4	19.2	20.2
Cooling air requirement	m³/s	1.56	1.56	1.56
Sound pressure level at 50/60 Hz	dB(A)	73/76	73/76	73/76
Line connection Recommended: DIN VDE AWG / MCM Maximum: DIN VDE AWG / MCM Fastening screw	 mm^2 mm^2 	Per sub-cabinet: 2 x 240 2 x (600) 4 x 240 4 x (600) M12 (2 holes)	Per sub-cabinet: 2 x 300 2 x (800) 4 x 240 4 x (600) M12 (2 holes)	Per sub-cabinet: 4 x 150 4 x (400) 8 x 240 8 x (600) M12 (4 holes)
Motor connection Recommended: DIN VDE AWG / MCM Maximum: DIN VDE AWG / MCM Fastening screw	 mm^2 mm^2 	Per sub-cabinet: 2 x 185 2 x (500) 4 x 240 4 x (600) M12 (2 holes)	Per sub-cabinet: 3 x 150 3 x (400) 4 x 240 4 x (600) M12 (2 holes)	Per sub-cabinet: 3 x 185 3 x (500) 4 x 240 4 x (600) M12 (2 holes)
PE conductor connection Fastening screw		Per sub-cabinet: M12 (2 holes)	Per sub-cabinet: M12 (10 holes)	Per sub-cabinet: M12 (16 holes)
Approx. weight (standard version)	kg	1700	1710	2130
Power block type		HX	HX	HX
Dimensions (standard version) (W x H x D)	 mm	 2400 x 2000 x 600	 2400 x 2000 x 600	 2400 x 2000 x 600
Recommended protection Conductor protection (with option L26) Rated current Size to DIN 43 620-1 Cond./semi-cond. protection (without option L26) Rated current Size to DIN 43 620-1	 A A 	 Per sub-cabinet: 3NA3 475 800 4 Per sub-cabinet: 3NE1 438-2 800 3	 Per sub-cabinet: 3NA3 475 800 4 Per sub-cabinet: 3NE1 448-2 850 3	 Per sub-cabinet: Circuit-breaker Per sub-cabinet: Circuit-breaker

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

12.3.2 Cabinet Unit Version C, 380 V – 480 V 3AC

Table 12-13 Version C, 380 V – 480 V 3AC, part 1

Category	Unit			
Order no. **6SL3710-**		**1GE32-1CA0**	**1GE32-6CA0**	**1GE33-1CA0**
Rated motor output At 400 V, 50 Hz At 460 V, 60 Hz	 kW hp	 110 150	 132 200	 160 250
Rated input voltage	V	3 AC 380 V to 480 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	239	294	348
Rated output current	A	210	260	310
Base load current I_L [2]	A	205	250	302
Base load current I_H [3]	A	178	233	277
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	2.9	3.8	4.4
Cooling air requirement	m³/s	0.17	0.23	0.36
Sound pressure level at 50/60 Hz	dB(A)	67/68	69/73	69/73
Line connection Recommended: DIN VDE AWG / MCM Maximum: DIN VDE AWG / MCM Fastening screw	 mm^2 mm^2 	 2 x 50 2 x (00) 2 x 240 2 x (600) M12 (1 hole)	 2 x 70 2 x (000) 2 x 240 2 x (600) M12 (1 hole)	 2 x 95 2 x (4/0) 2 x 240 2 x (600) M12 (1 hole)
Motor connection Recommended: DIN VDE AWG / MCM Maximum: DIN VDE AWG / MCM Fastening screw	 mm^2 mm^2 	 2 x 50 2 x (00) 2 x 150 2 x (400) M12 (1 hole)	 2 x 70 2 x (000) 2 x 150 2 x (400) M12 (1 hole)	 2 x 95 2 x (4/0) 2 x 150 2 x (400) M12 (1 hole)
PE conductor connection Fastening screw		 M12 (2 holes)	 M12 (2 holes)	 M12 (2 holes)
Approx. weight (standard version)	kg	225	225	300
Power block type		FX	FX	GX
Dimensions (standard version) (W x H x D)	 mm	 400 x 2000 x 600	 400 x 2000 x 600	 400 x 2000 x 600
Recommended protection Cond./semi-cond. protection Rated current Size to DIN 43 620-1	 A 	 3NE1 230-2 315 1	 3NE1 331-2 350 2	 3NE1 334-2 500 2

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-14 Version C, 380 V – 480 V 3AC, part 2

Category	Unit			
Order no. **6SL3710-**		**1GE33-8CA0**	**1GE35-0CA0**	**1GE36-1CA0**
Rated motor output At 400 V, 50 Hz At 460 V, 60 Hz	 kW hp	 200 300	 250 400	 315 500
Rated input voltage	V	3 AC 380 V to 480 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	405	519	639
Rated output current	A	380	490	605
Base load current I_L [2]	A	370	477	590
Base load current I_H [3]	A	340	438	460
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	5.3	6.4	8.2
Cooling air requirement	m³/s	0.36	0.36	0.78
Sound pressure level at 50/60 Hz	dB(A)	69/73	69/73	70/73
Line connection Recommended: DIN VDE AWG / MCM Maximum: DIN VDE AWG / MCM Fastening screw	 mm^2 mm^2 	 2 x 120 2 x (300) 2 x 240 2 x (600) M12 (1 hole)	 2 x 185 2 x (500) 2 x 240 2 x (600) M12 (1 hole)	 2 x 240 2 x (600) 8 x 240 8 x (600) M12 (4 holes)
Motor connection Recommended: DIN VDE AWG / MCM Maximum: DIN VDE AWG / MCM Fastening screw	 mm^2 mm^2 	 2 x 95 2 x (4/0) 2 x 150 2 x (400) M12 (1 hole)	 2 x 150 2 x (400) 2 x 240 2 x (600) M12 (1 hole)	 2 x 185 2 x (500) 8 x 240 8 x (600) M12 (4 holes)
PE conductor connection Fastening screw		 M12 (2 holes)	 M12 (2 holes)	 M12 (2 holes)
Approx. weight (standard version)	kg	300	300	670
Power block type		GX	GX	HX
Dimensions (standard version) (W x H x D)	 mm	 400 x 2000 x 600	 400 x 2000 x 600	 600 x 2000 x 600
Recommended protection Cond./semi-cond. protection Rated current Size to DIN 43 620-1	 A 	 3NE1 334-2 500 2	 3NE1 436-2 630 3	 3NE1 438-2 800 3

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-15 Version C, 380 V – 480 V 3AC, part 3

Category	Unit			
Order no. **6SL3710-**		**1GE37-5CA0**	**1GE38-4CA0**	**1GE41-0CA0**
Rated motor output At 400 V, 50 Hz At 460 V, 60 Hz	 kW hp	 400 600	 450 700	 560 800
Rated input voltage	V	3 AC 380 V to 480 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	785	883	1034
Rated output current	A	745	840	985
Base load current I_L [2]	A	725	820	960
Base load current I_H [3]	A	570	700	860
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	9.6	10.1	14.4
Cooling air requirement	m³/s	0.78	0.78	1.48
Sound pressure level at 50/60 Hz	dB(A)	70/73	70/73	72/75
Line connection Recommended: DIN VDE AWG / MCM Maximum: DIN VDE AWG / MCM Fastening screw	 mm^2 mm^2 	 2 x 300 2 x (800) 8 x 240 8 x (600) M12 (4 holes)	 4 x 150 4 x (400) 8 x 240 8 x (600) M12 (4 holes)	 3 x 240 3 x (600) 8 x 240 8 x (600) M12 (4 holes)
Motor connection Recommended: DIN VDE AWG / MCM Maximum: DIN VDE AWG / MCM Fastening screw	 mm^2 mm^2 	 3 x 150 3 x (400) 8 x 240 8 x (600) M12 (4 holes)	 3 x 185 3 x (500) 8 x 240 8 x (600) M12 (4 holes)	 4 x 185 4 x (500) 8 x 240 8 x (600) M12 (4 holes)
PE conductor connection Fastening screw		 M12 (8 holes)	 M12 (8 holes)	 M12 (10 holes)
Approx. weight (standard version)	kg	670	670	980
Power block type		HX	HX	JX
Dimensions (standard version) (W x H x D)	 mm	 600 x 2000 x 600	 600 x 2000 x 600	 1000 x 2000 x 600
Recommended protection Cond./semi-cond. protection Rated current Size to DIN 43 620-1	 A 	 3NE1 448-2 850 3	 Circuit-breaker 	 Circuit-breaker

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

12.3.3 Cabinet Unit Version A, 500 V – 600 V 3AC

Table 12-16 Version A, 500 V – 600 V 3AC, part 1

Category	Unit			
Order no. **6SL3710-**		**1GF31-8AA0**	**1GF32-2AA0**	**1GF32-6AA0**
Rated motor output	kW	110	132	160
Rated input voltage	V	3 AC 500 V to 600 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	201	234	280
Rated output current	A	175	215	260
Base load current I_L [2]	A	170	208	250
Base load current I_H [3]	A	157	192	233
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	3.5	3.9	4.4
Cooling air requirement	m³/s	0.36	0.36	0.36
Sound pressure level at 50/60 Hz	dB(A)	69/73	68/73	69/73
Line connection				
Recommended: DIN VDE	mm^2	120	2 x 70	2 x 95
AWG / MCM		(300)	2 x (000)	2 x (4/0)
Maximum: DIN VDE	mm^2	4 x 240	4 x 240	4 x 240
AWG / MCM		4 x (600)	4 x (600)	4 x (600)
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
Motor connection				
Recommended: DIN VDE	mm^2	95	120	2 x 70
AWG / MCM		(4/0)	(300)	2 x (000)
Maximum: DIN VDE	mm^2	2 x 150	2 x 150	2 x 185
AWG / MCM		2 x (400)	2 x (400)	2 x (500)
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
PE conductor connection				
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
Approx. weight (standard version)	kg	390	390	390
Power block type		GX	GX	GX
Dimensions (standard version) (W x H x D)	mm	800 x 2000 x 600	800 x 2000 x 600	800 x 2000 x 600
Recommended protection				
Conductor protection (with option L26)		3NA3 244-6	3NA3 252-6	3NA3 354-6
Rated current	A	250	315	355
Size to DIN 43 620-1		2	2	3
Cond./semi-cond. protection (without option L26)		3NE1 227-2	3NE1 230-2	3NE1 331-2
Rated current	A	250	315	350
Size to DIN 43 620-1		1	1	2

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-17 Version A, 500 V – 600 V 3AC, part 2

Category	Unit			
Order no. **6SL3710-**		**1GF33-3AA0**	**1GF34-1AA0**	**1GF34-7AA0**
Rated motor output	kW	200	250	315
Rated input voltage	V	3 AC 500 V to 600 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	353	436	493
Rated output current	A	330	410	465
Base load current I_L [2]	A	320	400	452
Base load current I_H [3]	A	280	367	416
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	5.4	6.9	7.8
Cooling air requirement	m³/s	0.36	0.78	0.78
Sound pressure level at 50/60 Hz	dB(A)	69/73	72/75	72/75
Line connection				
Recommended: DIN VDE AWG / MCM	mm^2	2 x 120 2 x (300)	2 x 185 2 x (500)	2 x 185 2 x (500)
Maximum: DIN VDE AWG / MCM	mm^2	4 x 240 4 x (600)	4 x 240 4 x (600)	4 x 240 4 x (600)
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
Motor connection				
Recommended: DIN VDE AWG/ MCM	mm^2	2 x 95 2 x (4/0)	2 x 120 2 x (300)	2 x 150 2 x (400)
Maximum: DIN VDE AWG/ MCM	mm^2	2 x 240 2 x (600)	4 x 240 4 x (600)	4 x 240 4 x (600)
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
PE conductor connection				
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
Approx. weight (standard version)	kg	390	860	860
Power block type		GX	HX	HX
Dimensions (standard version) (W x H x D)	mm	800 x 2000 x 600	1200 x 2000 x 600	1200 x 2000 x 600
Recommended protection				
Conductor protection (with option L26) Rated current Size to DIN 43 620-1	 A 	 3NA3 365-6 500 3	 3NA3 365-6 500 3	 3NA3 255-6 2 x 315 3
Cond./semi-cond. protection (without option L26) Rated current Size to DIN 43 620-1	 A 	 3NE1 334-2 500 2	 3NE1 334-2 500 2	 3NE1 435-2 560 3

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-18 Version A, 500 V – 600 V 3AC, part 3

Category	Unit			
Order no. **6SL3710-**		**1GF35-8AA0**	**1GF37-4AA0**	**1GF38-1AA0**
Rated motor output	kW	400	500	560
Rated input voltage	V	3 AC 500 V to 600 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	608	774	852
Rated output current	A	575	735	810
Base load current I_L [2]	A	560	710	790
Base load current I_H [3]	A	514	657	724
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	8.7	12.7	14.1
Cooling air requirement	m³/s	0.78	1.48	1.48
Sound pressure level at 50/60 Hz	dB(A)	72/75	72/75	72/75
Line connection				
Recommended: DIN VDE AWG / MCM	mm^2	2 x 240 2 x (600)	3 x 185 3 x (500)	4 x 150 4 x (400)
Maximum: DIN VDE AWG / MCM	mm^2	4 x 240 4 x (600)	8 x 240 8 x (600)	8 x 240 8 x (600)
Fastening screw		M12 (2 holes)	M12 (4 holes)	M12 (4 holes)
Motor connection				
Recommended: DIN VDE AWG / MCM	mm^2	2 x 185 2 x (500)	3 x 150 3 x (400)	3 x 185 3 x (500)
Maximum: DIN VDE AWG / MCM	mm^2	4 x 240 4 x (600)	6 x 240 6 x (600)	6 x 240 6 x (600)
Fastening screw		M12 (2 holes)	M12 (3 holes)	M12 (3 holes)
PE conductor connection				
Fastening screw		M12 (2 holes)	M12 (18 holes)	M12 (18 holes)
Approx. weight (standard version)	kg	860	1320	1360
Power block type		HX	JX	JX
Dimensions (standard version) (W x H x D)	mm	1200 x 2000 x 600	1600 x 2000 x 600	1600 x 2000 x 600
Recommended protection				
Conductor protection (with option L26) Rated current Size to DIN 43 620-1	A	3NA3 354-6 2 x 355 3	3NA3 365-6 2 x 500 3	Circuit-breaker
Cond./semi-cond. protection (without option L26) Rated current Size to DIN 43 620-1	A	3NE1 447-2 670 3	3NE1 448-2 850 3	Circuit-breaker

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-19 Version A, 500 V – 600 V 3AC, part 4

Category	Unit			
Order no. **6SL3710-**		**2GF38-6AA0**	**2GF41-1AA0**	**2GF41-4AA0**
Rated motor output	kW	630	710	1000
Rated input voltage	V	3 AC 500 V to 600 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	904	1116	1424
Rated output current	A	860	1070	1360
Base load current I_L [2]	A	836	1036	1314
Base load current I_H [3]	A	770	950	1216
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	15.6	17.4	25.4
Cooling air requirement	m³/s	1.56	1.56	2.96
Sound pressure level at 50/60 Hz	dB(A)	75/78	75/78	75/78
Line connection		Per sub-cabinet:	Per sub-cabinet:	Per sub-cabinet:
Recommended: DIN VDE AWG / MCM	mm^2	2 x 185 2 x (500)	2 x 240 2 x (600)	3 x 185 3 x (500)
Maximum: DIN VDE AWG / MCM	mm^2	4 x 240 4 x (600)	4 x 240 4 x (600)	8 x 240 8 x (600)
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (4 holes)
Motor connection		Per sub-cabinet:	Per sub-cabinet:	Per sub-cabinet:
Recommended: DIN VDE AWG / MCM	mm^2	2 x 150 2 x (400)	2 x 185 2 x (500)	3 x 150 3 x (400)
Maximum: DIN VDE AWG / MCM	mm^2	4 x 240 4 x (600)	4 x 240 4 x (600)	6 x 240 6 x (600)
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (3 holes)
PE conductor connection		Per sub-cabinet:	Per sub-cabinet:	Per sub-cabinet:
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (18 holes)
Approx. weight (standard version)	kg	1700	1700	2620
Power block type		HX	HX	JX
Dimensions (standard version) (W x H x D)	mm	2400 x 2000 x 600	2400 x 2000 x 600	3200 x 2000 x 600
Recommended protection				
Conductor protection (with option L26) Rated current Size to DIN 43 620-1	 A 	Per sub-cabinet: 3NA3 255-6 2 x 315 3	Per sub-cabinet: 3NA3 354-6 2 x 355 3	Per sub-cabinet: 3NA3 365-6 2 x 500 3
Cond./semi-cond. protection (without option L26) Rated current Size to DIN 43 620-1	 A 	Per sub-cabinet: 3NE1 435-2 560 3	Per sub-cabinet: 3NE1 447-2 670 3	Per sub-cabinet: 3NE1 448-2 850 3

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

12.3.4 Cabinet Unit Version C, 500 V – 600 V 3AC

Table 12-20 Version C, 500 V – 600 V 3AC, part 1

Category	Unit			
Order no. **6SL3710-**		**1GF31-8CA0**	**1GF32-2CA0**	**1GF32-6CA0**
Rated motor output	kW	110	132	160
Rated input voltage	V	3 AC 500 V to 600 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	201	234	280
Rated output current	A	175	215	260
Base load current I_L [2]	A	170	208	250
Base load current I_H [3]	A	157	192	233
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	3.5	3.9	4.4
Cooling air requirement	m³/s	0.36	0.36	0.36
Sound pressure level at 50/60 Hz	dB(A)	69/73	69/73	69/73
Line connection				
Recommended: DIN VDE AWG / MCM	mm^2	120 (300)	2 x 70 2 x (000)	2 x 95 2 x (4/0)
Maximum: DIN VDE AWG / MCM	mm^2	2 x 240 2 x (600)	2 x 240 2 x (600)	4 x 240 4 x (600)
Fastening screw		M12 (1 hole)	M12 (1 hole)	M12 (1 hole)
Motor connection				
Recommended: DIN VDE AWG / MCM	mm^2	95 (4/0)	120 (300)	2 x 70 2 x (000)
Maximum: DIN VDE AWG / MCM	mm^2	2 x 150 2 x (400)	2 x 150 2 x (400)	2 x 240 2 x (600)
Fastening screw		M12 (1 hole)	M12 (1 hole)	M12 (1 hole)
PE conductor connection				
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
Approx. weight (standard version)	kg	300	300	300
Power block type		GX	GX	GX
Dimensions (standard version) (W x H x D)	mm	400 x 2000 x 600	400 x 2000 x 600	400 x 2000 x 600
Recommended protection				
Cond./semi-cond. protection Rated current Size to DIN 43 620-1	A	3NE1 227-2 250 1	3NE1 230-2 315 1	3NE1 331-2 350 2

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-21 Version C, 500 V – 600 V 3AC, part 2

Category	Unit			
Order no. **6SL3710-**		**1GF33-3CA0**	**1GF34-1CA0**	**1GF34-7CA0**
Rated motor output	kW	200	250	315
Rated input voltage	V	3 AC 500 V to 600 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	353	436	493
Rated output current	A	330	410	465
Base load current I_L [2]	A	320	400	452
Base load current I_H [3]	A	280	367	416
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	5.4	6.9	7.8
Cooling air requirement	m³/s	0,.36	0.78	0.78
Sound pressure level at 50/60 Hz	dB(A)	69/73	72/75	72/75
Line connection				
Recommended: DIN VDE AWG / MCM	mm^2	2 x 120 2 x (300)	2 x 185 2 x (500)	2 x 185 2 x (500)
Maximum: DIN VDE AWG / MCM	mm^2	2 x 240 2 x (600)	4 x 240 4 x (600)	4 x 240 4 x (600)
Fastening screw		M12 (1 hole)	M12 (2 holes)	M12 (2 holes)
Motor connection				
Recommended: DIN VDE AWG / MCM	mm^2	2 x 95 2 x (4/0)	2 x 120 2 x (300)	2 x 150 2 x (400)
Maximum: DIN VDE AWG / MCM	mm^2	2 x 240 2 x (600)	4 x 240 4 x (600)	4 x 240 4 x (600)
Fastening screw		M12 (1 hole)	M12 (2 holes)	M12 (2 holes)
PE conductor connection				
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
Approx. weight (standard version)	kg	300	670	670
Power block type		GX	HX	HX
Dimensions (standard version) (W x H x D)	mm	400 x 2000 x 600	600 x 2000 x 600	600 x 2000 x 600
Recommended protection				
Cond./semi-cond. protection Rated current Size to DIN 43 620-1	A	3NE1 334-2 500 2	3NE1 334-2 500 2	3NE1 435-2 560 3

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-22 Version C, 500 V – 600 V 3AC, part 3

Category	Unit			
Order no. **6SL3710-**		**1GF35-8CA0**	**1GF37-4CA0**	**1GF38-1CA0**
Rated motor output	kW	400	500	560
Rated input voltage	V	3 AC 500 V to 600 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	608	774	852
Rated output current	A	575	735	810
Base load current I_L [2]	A	560	710	790
Base load current I_H [3]	A	514	657	724
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	8.7	12.7	14.1
Cooling air requirement	m³/s	0.78	1.48	1.48
Sound pressure level at 50/60 Hz	dB(A)	72/75	72/75	72/75
Line connection				
Recommended: DIN VDE AWG / MCM	mm^2	2 x 240 2 x (600)	3 x 185 3 x (500)	4 x 150 4 x (400)
Maximum: DIN VDE AWG / MCM	mm^2	4 x 240 4 x (600)	8 x 240 8 x (600)	8 x 240 8 x (600)
Fastening screw		M12 (2 holes)	M12 (4 holes)	M12 (4 holes)
Motor connection				
Recommended: DIN VDE AWG/ MCM	mm^2	2 x 185 2 x (500)	3 x 150 3 x (400)	3 x 185 3 x (500)
Maximum: DIN VDE AWG/ MCM	mm^2	4 x 240 4 x (600)	6 x 240 6 x (600)	6 x 240 6 x (600)
Fastening screw		M12 (2 holes)	M12 (3 holes)	M12 (3 holes)
PE conductor connection				
Fastening screw		M12 (2 holes)	M12 (18 holes)	M12 (18 holes)
Approx. weight (standard version)	kg	670	940	980
Power block type		HX	JX	JX
Dimensions (standard version) (W x H x D)	mm	600 x 2000 x 600	1000 x 2000 x 600	1000 x 2000 x 600
Recommended protection				
Cond./semi-cond. protection Rated current Size to DIN 43 620-1	A	3NE1 447-2 670 3	3NE1 448-2 850 3	Circuit-breaker

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

12.3.5 Cabinet Unit Version A, 660 V – 690 V 3AC

Table 12-23 Version A, 660 V – 690 V 3AC, part 1

Category	Unit			
Order no. **6SL3710-**		**1GH28-5AA0**	**1GH31-0AA0**	**1GH31-2AA0**
Rated motor output	kW	75	90	110
Rated input voltage	V	3 AC 660 V to 690 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	103	119	141
Rated output current	A	85	100	120
Base load current I_L [2]	A	80	95	115
Base load current I_H [3]	A	76	89	107
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	1.7	2.1	2.7
Cooling air requirement	m³/s	0.17	0.17	0.17
Sound pressure level at 50/60 Hz	dB(A)	67/68	67/68	67/68
Line connection				
Recommended: DIN VDE	mm^2	50	50	70
AWG / MCM		(00)	(00)	(000)
Maximum: DIN VDE	mm^2	4 x 240	4 x 240	4 x 240
AWG / MCM		4 x (600)	4 x (600)	4 x (600)
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
Motor connection				
Recommended: DIN VDE	mm^2	35	50	70
AWG/ MCM		(0)	(00)	(000)
Maximum: DIN VDE	mm^2	2 x 70	2 x 150	2 x 150
AWG/ MCM		2 x (000)	2 x (400)	2 x (400)
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
PE conductor connection				
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
Approx. weight (standard version)	kg	320	320	320
Power block type		FX	FX	FX
Dimensions (standard version) (W x H x D)	mm	800 x 2000 x 600	800 x 2000 x 600	800 x 2000 x 600
Recommended protection				
Conductor protection (with option L26)		3NA3 132-6	3NA3 132-6	3NA3 136-6
Rated current	A	125	125	160
Size to DIN 43 620-1		1	1	1
Cond./semi-cond. protection (without option L26)		3NE1 022-2	3NE1 022-2	3NE1 224-2
Rated current	A	125	125	160
Size to DIN 43 620-1		00	00	1

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-24 Version A, 660 V – 690 V 3AC, part 2

Category	Unit			
Order no. **6SL3710-**		**1GH31-5AA0**	**1GH31-8AA0**	**1GH32-2AA0**
Rated motor output	kW	132	160	200
Rated input voltage	V	3 AC 660 V to 690 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	168	201	234
Rated output current	A	150	175	215
Base load current I_L [2]	A	142	170	208
Base load current I_H [3]	A	134	157	192
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	2.8	3.8	4.2
Cooling air requirement	m³/s	0.17	0.36	0.36
Sound pressure level at 50/60 Hz	dB(A)	67/68	69/73	69/73
Line connection				
Recommended: DIN VDE AWG / MCM	mm^2	95 (4/0)	120 (300)	2 x 70 2 x (000)
Maximum: DIN VDE AWG / MCM	mm^2	4 x 240 4 x (600)	4 x 240 4 x (600)	4 x 240 4 x (600)
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
Motor connection				
Recommended: DIN VDE AWG/ MCM	mm^2	70 (000)	95 (4/0)	120 (300)
Maximum: DIN VDE AWG/ MCM	mm^2	2 x 150 2 x (400)	2 x 150 2 x (400)	2 x 150 2 x (400)
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
PE conductor connection				
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
Approx. weight (standard version)	kg	320	390	390
Power block type		FX	GX	GX
Dimensions (standard version) (W x H x D)	mm	800 x 2000 x 600	800 x 2000 x 600	800 x 2000 x 600
Recommended protection				
Conductor protection (with option L26) Rated current Size to DIN 43 620-1	 A	 3NA3 240-6 200 2	 3NA3 244-6 250 2	 3NA3 252-6 315 2
Cond./semi-cond. protection (without option L26) Rated current Size to DIN 43 620-1	 A	 3NE1 225-2 200 1	 3NE1 227-2 250 1	 3NE1 230-2 315 1

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-25 Version A, 660 V – 690 V 3AC, part 3

Category	Unit			
Order no. **6SL3710-**		**1GH32-6AA0**	**1GH33-3AA0**	**1GH34-1AA0**
Rated motor output	kW	250	315	400
Rated input voltage	V	3 AC 660 V to 690 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	280	353	436
Rated output current	A	260	330	410
Base load current I_L [2]	A	250	320	400
Base load current I_H [3]	A	233	280	367
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	5.0	6.1	8.1
Cooling air requirement	m³/s	0.36	0.36	0.78
Sound pressure level at 50/60 Hz	dB(A)	69/73	69/73	72/75
Line connection				
Recommended: DIN VDE AWG / MCM	mm^2	2 x 95 2 x (4/0)	2 x 120 2 x (300)	2 x 185 2 x (500)
Maximum: DIN VDE AWG / MCM	mm^2	4 x 240 4 x (600)	4 x 240 4 x (600)	4 x 240 4 x (600)
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
Motor connection				
Recommended: DIN VDE AWG/ MCM	mm^2	2 x 70 2 x (000)	2 x 95 2 x (4/0)	2 x 120 2 x (300)
Maximum: DIN VDE AWG/ MCM	mm^2	2 x 185 2 x (500)	2 x 240 2 x (600)	4 x 240 4 x (600)
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
PE conductor connection				
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
Approx. weight (standard version)	kg	390	390	860
Power block type		GX	GX	HX
Dimensions (standard version) (W x H x D)	mm	800 x 2000 x 600	800 x 2000 x 600	1200 x 2000 x 600
Recommended protection				
Conductor protection (with option L26) Rated current Size to DIN 43 620-1	 A 	 3NA3 354-6 355 3	 3NA3 365-6 500 3	 3NA3 365-6 500 3
Cond./semi-cond. protection (without option L26) Rated current Size to DIN 43 620-1	 A 	 3NE1 331-2 350 2	 3NE1 334-2 500 2	 3NE1 334-2 500 2

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-26 Version A, 660 V – 690 V 3AC, part 4

Category	Unit			
Order no. **6SL3710-**		**1GH34-7AA0**	**1GH35-8AA0**	**1GH37-4AA0**
Rated motor output	kW	450	560	710
Rated input voltage	V	3 AC 660 V to 690 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	493	608	774
Rated output current	A	465	575	735
Base load current I_L [2]	A	452	560	710
Base load current I_H [3]	A	416	514	657
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	9.1	10.8	13.5
Cooling air requirement	m³/s	0.78	0.78	1.48
Sound pressure level at 50/60 Hz	dB(A)	72/75	72/75	72/75
Line connection				
Recommended: DIN VDE AWG/ MCM	mm^2	2 x 185 2 x (500)	2 x 240 2 x (600)	3 x 185 3 x (500)
Maximum: DIN VDE AWG/ MCM	mm^2	4 x 240 4 x (600)	4 x 240 4 x (600)	8 x 240 8 x (600)
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (4 holes)
Motor connection				
Recommended: DIN VDE AWG/ MCM	mm^2	2 x 150 2 x (400)	2 x 185 2 x (500)	3 x 150 3 x (400)
Maximum: DIN VDE AWG/ MCM	mm^2	4 x 240 4 x (600)	4 x 240 4 x (600)	6 x 240 6 x (600)
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (3 holes)
PE conductor connection				
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (18 holes)
Approx. weight (standard version)	kg	860	860	1320
Power block type		HX	HX	JX
Dimensions (standard version) (W x H x D)	mm	1200 x 2000 x 600	1200 x 2000 x 600	1600 x 2000 x 600
Recommended protection				
Conductor protection (with option L26) Rated current Size to DIN 43 620-1	 A 	 3NA3 252-6 2 x 315 3	 3NA3 354-6 2 x 355 3	 3NA3 365-6 2 x 500 3
Cond./semi-cond. protection (without option L26) Rated current Size to DIN 43 620-1	 A 	 3NE1 435-2 560 3	 3NE1 447-2 670 3	 3NE1 448-2 850 3

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-27 Version A, 660 V – 690 V 3AC, part 5

Category	Unit			
Order no. **6SL3710-**		**1GH38-1AA0**	**2GH41-1AA0**	**2GH41-4AA0**
Rated motor output	kW	800	1000	1350
Rated input voltage	V	3 AC 660 V to 690 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	852	1116	1424
Rated output current	A	810	1070	1360
Base load current I_L [2]	A	790	1036	1314
Base load current I_H [3]	A	724	950	1216
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	14.7	21.6	27.0
Cooling air requirement	m³/s	1.48	1.56	2.96
Sound pressure level at 50/60 Hz	dB(A)	72/75	75/78	75/78
Line connection			Per sub-cabinet:	Per sub-cabinet:
Recommended: DIN VDE AWG / MCM	mm^2	4 x 150 4 x (400)	2 x 240 2 x (600)	3 x 185 3 x (500)
Maximum: DIN VDE AWG/ MCM	mm^2	8 x 240 8 x (600)	4 x 240 4 x (600)	8 x 240 8 x (600)
Fastening screw		M12 (4 holes)	M12 (2 holes)	M12 (4 holes)
Motor connection			Per sub-cabinet:	Per sub-cabinet:
Recommended: DIN VDE AWG/ MCM	mm^2	3 x 185 3 x (500)	2 x 185 2 x (500)	3 x 150 3 x (400)
Maximum: DIN VDE AWG/ MCM	mm^2	6 x 240 6 x (600)	4 x 240 4 x (600)	6 x 240 6 x (600)
Fastening screw		M12 (3 holes)	M12 (2 holes)	M12 (3 holes)
PE conductor connection			Per sub-cabinet:	Per sub-cabinet:
Fastening screw		M12 (18 holes)	M12 (2 holes)	M12 (18 holes)
Approx. weight (standard version)	kg	1360	1700	2620
Power block type		JX	HX	JX
Dimensions (standard version) (W x H x D)	mm	1600 x 2000 x 600	2400 x 2000 x 600	3200 x 2000 x 600
Recommended protection				
Conductor protection (with option L26) Rated current Size to DIN 43 620-1	A	Circuit-breaker	Per sub-cabinet: 3NA3 354-6 2 x 355 3	Per sub-cabinet: 3NA3 365-6 2 x 500 3
Cond./semi-cond. protection (without option L26) Rated current Size to DIN 43 620-1	A	Circuit-breaker	Per sub-cabinet: 3NE1 447-2 670 3	Per sub-cabinet: 3NE1 448-2 850 3

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-28 Version A, 660 V – 690 V 3AC, part 6

Category	Unit			
Order no. **6SL3710-**		**2GH41-5AA0**		
Rated motor output	kW	1500		
Rated input voltage	V	3 AC 660 V to 690 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	1568		
Rated output current	A	1500		
Base load current I_L [2]	A	1462		
Base load current I_H [3]	A	1340		
Maximum output frequency [4]	Hz	100		
Power loss	kW	29.4		
Cooling air requirement	m³/s	2.96		
Sound pressure level at 50/60 Hz	dB(A)	75/78		
Line connection		Per sub-cabinet:		
Recommended: DIN VDE AWG / MCM	mm^2	4 x 150 4 x (400)		
Maximum: DIN VDE AWG/ MCM	mm^2	8 x 240 8 x (600)		
Fastening screw		M12 (4 holes)		
Motor connection		Per sub-cabinet:		
Recommended: DIN VDE AWG/ MCM	mm^2	3 x 185 3 x (500)		
Maximum: DIN VDE AWG/ MCM	mm^2	6 x 240 6 x (600)		
Fastening screw		M12 (3 holes)		
PE conductor connection		Per sub-cabinet:		
Fastening screw		M12 (18 holes)		
Approx. weight (standard version)	kg	2700		
Power block type		JX		
Dimensions (standard version) (W x H x D)	mm	3200 x 2000 x 600		
Recommended protection				
Conductor protection (with option L26) Rated current Size to DIN 43 620-1	 A 	Per sub-cabinet: Circuit-breaker		
Cond./semi-cond. protection (without option L26) Rated current Size to DIN 43 620-1	 A 	Per sub-cabinet: Circuit-breaker		

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

12.3.6 Cabinet Unit Version C, 660 V – 690 V 3AC

Table 12-29 Version C, 660 V – 690 V 3AC, part 1

Category	Unit			
Order no. **6SL3710-**		**1GH28-5CA0**	**1GH31-0CA0**	**1GH31-2CA0**
Rated motor output	kW	75	90	110
Rated input voltage	V	3 AC 660 V to 690 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	103	119	141
Rated output current	A	85	100	120
Base load current I_L [2]	A	80	95	115
Base load current I_H [3]	A	76	89	107
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	1.7	2.1	2.7
Cooling air requirement	m³/s	0.17	0.17	0.17
Sound pressure level at 50/60 Hz	dB(A)	67/68	67/68	67/68
Line connection				
Recommended: DIN VDE AWG / MCM	mm^2	50 (00)	50 (00)	70 (000)
Maximum: DIN VDE AWG/ MCM	mm^2	2 x 240 2 x (600)	2 x 240 2 x (600)	2 x 240 2 x (600)
Fastening screw		M12 (1 hole)	M12 (1 hole)	M12 (1 hole)
Motor connection				
Recommended: DIN VDE AWG/ MCM	mm^2	35 (0)	50 (00)	70 (000)
Maximum: DIN VDE AWG/ MCM	mm^2	2 x 70 2 x (000)	2 x 150 2 x (400)	2 x 150 2 x (400)
Fastening screw		M12 (1 hole)	M12 (1 hole)	M12 (1 hole)
PE conductor connection				
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
Approx. weight (standard version)	kg	225	225	225
Power block type		FX	FX	FX
Dimensions (standard version) (W x H x D)	mm	400 x 2000 x 600	400 x 2000 x 600	400 x 2000 x 600
Recommended protection				
Cond./semi-cond. protection Rated current Size to DIN 43 620-1	A	3NE1 022-2 125 00	3NE1 022-2 125 00	3NE1 224-2 160 1

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-30 Version C, 660 V – 690 V 3AC, part 2

Category	Unit			
Order no. **6SL3710-**		**1GH31-5CA0**	**1GH31-8CA0**	**1GH32-2CA0**
Rated motor output	kW	132	160	200
Rated input voltage	V	3 AC 660 V to 690 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	168	201	234
Rated output current	A	150	175	215
Base load current I_L [2]	A	142	170	208
Base load current I_H [3]	A	134	157	192
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	2.8	3.8	4.2
Cooling air requirement	m³/s	0.17	0.36	0.36
Sound pressure level at 50/60 Hz	dB(A)	67/68	69/73	69/73
Line connection				
Recommended: DIN VDE AWG/ MCM	mm^2	95 (4/0)	120 (300)	2 x 70 2 x (000)
Maximum: DIN VDE AWG/ MCM	mm^2	2 x 240 2 x (600)	2 x 240 2 x (600)	2 x 240 2 x (600)
Fastening screw		M12 (1 hole)	M12 (1 hole)	M12 (1 hole)
Motor connection				
Recommended: DIN VDE AWG/ MCM	mm^2	70 (000)	95 (4/0)	120 (300)
Maximum: DIN VDE AWG/ MCM	mm^2	2 x 150 2 x (400)	2 x 150 2 x (400)	2 x 150 2 x (400)
Fastening screw		M12 (1 hole)	M12 (1 hole)	M12 (1 hole)
PE conductor connection				
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
Approx. weight (standard version)	kg	225	300	300
Power block type		FX	GX	GX
Dimensions (standard version) (W x H x D)	mm	400 x 2000 x 600	400 x 2000 x 600	400 x 2000 x 600
Recommended protection				
Cond./semi-cond. protection Rated current Size to DIN 43 620-1	A	3NE1 225-2 200 1	3NE1 227-2 250 1	3NE1 230-2 315 1

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-31 Version C, 660 V – 690 V 3AC, part 3

Category	Unit			
Order no. **6SL3710-**		**1GH32-6CA0**	**1GH33-3CA0**	**1GH34-1CA0**
Rated motor output	kW	250	315	400
Rated input voltage	V	3 AC 660 V to 690 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	280	353	436
Rated output current	A	260	330	410
Base load current I_L [2]	A	250	320	400
Base load current I_H [3]	A	233	280	367
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	5.0	6.1	8.1
Cooling air requirement	m³/s	0.36	0.36	0.78
Sound pressure level at 50/60 Hz	dB(A)	69/73	69/73	72/75
Line connection				
Recommended: DIN VDE AWG/ MCM	mm^2	2 x 95 2 x (4/0)	2 x 120 2 x (300)	2 x 185 2 x (500)
Maximum: DIN VDE AWG/ MCM	mm^2	2 x 240 2 x (600)	2 x 240 2 x (600)	4 x 240 4 x (600)
Fastening screw		M12 (1 hole)	M12 (1 hole)	M12 (2 holes)
Motor connection				
Recommended: DIN VDE AWG/ MCM	mm^2	2 x 70 2 x (000)	2 x 95 2 x (4/0)	2 x 120 2 x (300)
Maximum: DIN VDE AWG/ MCM	mm^2	2 x 185 2 x (500)	2 x 240 2 x (600)	4 x 240 4 x (600)
Fastening screw		M12 (1 hole)	M12 (1 hole)	M12 (2 holes)
PE conductor connection				
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (2 holes)
Approx. weight (standard version)	kg	300	300	670
Power block type		GX	GX	HX
Dimensions (standard version) (W x H x D)	mm	400 x 2000 x 600	400 x 2000 x 600	600 x 2000 x 600
Recommended protection				
Cond./semi-cond. protection Rated current Size to DIN 43 620-1	A	3NE1 331-2 350 2	3NE1 334-2 500 2	3NE1 334-2 500 2

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-32 Version C, 660 V – 690 V 3AC, part 4

Category	Unit			
Order no. **6SL3710-**		**1GH34-7CA0**	**1GH35-8CA0**	**1GH37-4CA0**
Rated motor output	kW	450	560	710
Rated input voltage	V	3 AC 660 V to 690 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	493	608	774
Rated output current	A	465	575	735
Base load current I_L [2]	A	452	560	710
Base load current I_H [3]	A	416	514	657
Maximum output frequency [4]	Hz	100	100	100
Power loss	kW	9.1	10.8	13.5
Cooling air requirement	m³/s	0.78	0.78	1.48
Sound pressure level at 50/60 Hz	dB(A)	72/75	72/75	72/75
Line connection				
Recommended: DIN VDE AWG/ MCM	mm^2	2 x 185 2 x (500)	2 x 240 2 x (600)	3 x 185 3 x (500)
Maximum: DIN VDE AWG/ MCM	mm^2	4 x 240 4 x (600)	4 x 240 4 x (600)	8 x 240 8 x (600)
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (4 holes)
Motor connection				
Recommended: DIN VDE AWG/ MCM	mm^2	2 x 150 2 x (400)	2 x 185 2 x (500)	3 x 150 3 x (400)
Maximum: DIN VDE AWG/ MCM	mm^2	4 x 240 4 x (600)	4 x 240 4 x (600)	6 x 240 6 x (600)
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (3 holes)
PE conductor connection				
Fastening screw		M12 (2 holes)	M12 (2 holes)	M12 (18 holes)
Approx. weight (standard version)	kg	670	670	940
Power block type		HX	HX	JX
Dimensions (standard version) (W x H x D)	mm	600 x 2000 x 600	600 x 2000 x 600	1000 x 2000 x 600
Recommended protection				
Cond./semi-cond. protection Rated current Size to DIN 43 620-1	A	3NE1 435-2 560 3	3NE1 447-2 670 3	3NE1 448-2 850 3

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

Table 12-33 Version C, 660 V – 690 V 3AC, part 5

Category	Unit			
Order no. **6SL3710-**		**1GH38-1CA0**		
Rated motor output	kW	800		
Rated input voltage	V	3 AC 660 V to 690 V ±10 % (-15 % < 1 min)		
Rated input current [1]	A	852		
Rated output current	A	810		
Base load current I_L [2]	A	790		
Base load current I_H [3]	A	724		
Maximum output frequency [4]	Hz	100		
Power loss	kW	14.7		
Cooling air requirement	m³/s	1.48		
Sound pressure level at 50/60 Hz	dB(A)	72/75		
Line connection				
Recommended: DIN VDE AWG/ MCM	mm^2	4 x 150 4 x (400)		
Maximum: DIN VDE AWG/ MCM	mm^2	8 x 240 8 x (600)		
Fastening screw		M12 (4 holes)		
Motor connection				
Recommended: DIN VDE AWG/ MCM	mm^2	3 x 185 3 x (500)		
Maximum: DIN VDE AWG/ MCM	mm^2	6 x 240 6 x (600)		
Fastening screw		M12 (3 holes)		
PE conductor connection				
Fastening screw		M12 (18 holes)		
Approx. weight (standard version)	kg	980		
Power block type		JX		
Dimensions (standard version) (W x H x D)	mm	1000 x 2000 x 600		
Recommended protection				
Cond./semi-cond. protection Rated current Size to DIN 43 620-1	A	Circuit-breaker		

[1] The currents include 10 A for the external auxiliary equipment (as used, for example, with options L19 or B03).

[2] The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[3] The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

[4] Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.5; for derating data, see 12.2.1).

■

List of Abbreviations

A...	Alarm
AC	Alternating current
AD, ADC	Analog-Digital Converter
ADR	Address
AI	Analog Input
AO	Analog output
AOP	Advanced Operator Panel
BERO	Tradename for a type of proximity switch
BI	Binector Input
BICO	Binector / Connector
BO	Binector Output
C	Capacitance
CAN	Serial bus system
CB	Communication Board
CD	Compact Disc
CDS	Command Data Set
CI	Connector Input
CMD	Command
COM	Mid-position contact of a changeover contact
CPU	Central Processing Unit
CT	Constant Torque
CU	Control Unit
DA, DAC	Digital-Analog Converter
DC	Direct Current
DDS	Drive Data Set
DI	Digital input
DI/DO	Bidirectional Digital Input/Output
DO	Digital Output
EMC	Electromagnetic Compatibility
EN	European standard
ESD	Electrostatic Sensitive Devices (ESD)
F ...	Fault
FAQ	Frequently Asked Questions
FI	Residual Current Circuit Breaker
Float	Floating point number
FW	Firmware
HW	Hardware
I/O	Input/Output
IEC	International Electrotechnical Commission

IGBT	Insulated Gate Bipolar Transistor
JOG	Jog
L	Inductance
LED	Light Emitting Diode
M	Ground
MB	Megabyte
MDS	Motor Data Set
NC	Normally-closed contact
NEMA	National Electrical Manufacturers Association
NO	Normally-open contact
OEM	Original Equipment Manufacturer
Order No.	Machine-readable product designation
p ...	Variable parameters
PDS	Power Module Data Set
PE	Protective Earth
PROFIBUS	Process Field Bus
PTC	Positive Temperature Coefficient
PZD	PROFIBUS process data
r ...	Visualization parameter (read only)
RAM	Random Access Memory
RFG	Ramp-Function Generator
RS232	Serial interface
RS485	Standard. Describes the physical characteristics of a digital serial interface.
S1	Continuous Duty
S3	Periodic Duty
SH	Safe standstill
SI	Safety Integrated
SPS	Programmable Logic Controller (PLC)
STW	PROFIBUS Control Word
SW	Software
TIA	Totally Integrated Automation
TM	Terminal Module
UL	Underwriters Laboratories Inc.
Vdc	DC link voltage
VDE	Association of German Electrical Engineers
VDI	Association of German Engineers
VT	Variable torque
ZK	DC Link
ZSW	PROFIBUS status word

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Parameter Macros

Parameter macro p0015 = G150 cabinet unit

This macro is used to make default settings for operating the cabinet unit.

Table 1 Parameter macro p0015 = G150 cabinet unit

Sink			Source		
Parameter	**Description**	**DO**	**Parameter**	**Description**	**DO**
p0400[0]	Encoder type selection	Vector	9999	Other	Vector
p0404[0]	Encoder configuration effective	Vector	200008h		Vector
p0405[0]	Squarewave signal encoder A/B track	Vector	9h	Bipolar (like A/B track)	Vector
p0408[0]	Rotary encoder pulses/rev	Vector	1024	1024 pulses per environment	Vector
p0500	Technological application	Vector	1	Pumps, fans	Vector
p0600	Motor temperature sensor for monitoring	Vector	0	No sensor	Vector
p0601	Motor temperature sensor type	Vector	0	No sensor	Vector
p0603[0]	CI: Motor temperature	Vector	r4105	Sensor on TM31	TM31
p0603[1]	CI: Motor temperature	Vector			
p0604	Motor temperature alarm threshold	Vector	120	(factory setting)	Vector
p0605	Motor temperature fault threshold	Vector	155	(factory setting)	Vector
p0606	Motor temperature timer	Vector	0	(factory setting)	Vector
p0610	Response to motor overtemperature condition	Vector	1	Display fault, with alarm Imax red.	Vector
p0700[0]	Preset binector input	Vector	70006	S/G150 terminal block	Vector
p0864	Infeed operation	Vector	1		
p1000[0]	Preset connector input	Vector	10002	TM31_AI0	Vector
p1001	CO: Fixed speed setpoint 1	Vector	300 RPM		Vector
p1002	CO: Fixed speed setpoint 2	Vector	600 RPM		Vector
p1003	CO: Fixed speed setpoint 3	Vector	1500 RPM		Vector
p1083	CO: Speed limit in positive direction of rotation	Vector	6000 RPM		Vector
p1086	CO: Speed limit negative direction of rotation	Vector	-6000 RPM		Vector
p1115	Ramp-function generator selection	Vector	1	Extended ramp-function generator	Vector

Sink			Source		
Parameter	**Description**	**DO**	**Parameter**	**Description**	**DO**
p1120	Ramp-function generator ramp-up time	Vector	20 s		Vector
p1121	Ramp-function generator ramp-down time	Vector	30 s		Vector
p1135	OFF3 ramp-down time	Vector	10 s		Vector
p1200	FlyRest oper mode	Vector	0	Flying restart inactive	Vector
p1240	Vdc controller configuration	Vector	0	Vdc-max controller enabled	Vector
p1280	Vdc controller configuration (V/f)	Vector	0	Vdc-max controller enabled	Vector
p1300	Open-loop/closed-loop control operating mode	Vector	20	Speed control (sensorless)	Vector
p1911	Number of phases to be identified	Vector	3	3 phases	Vector
p2051[0]	CI: PROFIBUS PZD send word	Vector	r2089[0]	ZSW1	Vector
p2051[1]	CI: PROFIBUS PZD send word	Vector	r0063	n-act	Vector
p2051[2]	CI: PROFIBUS PZD send word	Vector	r0068	I-act	Vector
p2051[3]	CI: PROFIBUS PZD send word	Vector	r0080	M-act	Vector
p2051[4]	CI: PROFIBUS PZD send word	Vector	r0082	P-act	Vector
p2051[5]	CI: PROFIBUS PZD send word	Vector	r2131	FAULT	Vector
p2080[0]	BI: PROFIBUS send status word 1	Vector	r0899[0]	Ready to power up	Vector
p2080[1]	BI: PROFIBUS send status word 1	Vector	r0899[1]	Ready to run	Vector
p2080[2]	BI: PROFIBUS send status word 1	Vector	r0899[2]	Warning	Vector
p2080[3]	BI: PROFIBUS send status word 1	Vector	r2139[3]	Fault	Vector
p2080[4]	BI: PROFIBUS send status word 1	Vector	r0899[4]	OFF2 inactive	Vector
p2080[5]	BI: PROFIBUS send status word 1	Vector	r0899[5]	OFF3 inactive	Vector
p2080[6]	BI: PROFIBUS send status word 1	Vector	r0899[6]	Power-on inhibit	Vector
p2080[7]	BI: PROFIBUS send status word 1	Vector	r2139[7]	Alarm present	Vector
p2080[8]	BI: PROFIBUS send status word 1	Vector	r2197[7]	No setpoint/actual value deviation	Vector
p2080[9]	BI: PROFIBUS send status word 1	Vector	r0899[9]	Control from the PLC	Vector

Sink			Source		
Parameter	**Description**	**DO**	**Parameter**	**Description**	**DO**
p2080[10]	BI: PROFIBUS send status word 1	Vector	r2199[1]	Comparison value reached	Vector
p2080[11]	BI: PROFIBUS send status word 1	Vector	r1407[7]	M/I/P limiting not active	Vector
p2080[12]	BI: PROFIBUS send status word 1	Vector	0		Vector
p2080[13]	BI: PROFIBUS send status word 1	Vector	r2129[14]	No motor overtemperature alarm	Vector
p2080[14]	BI: PROFIBUS send status word 1	Vector	r2197[3]	Clockwise	Vector
p2080[15]	BI: PROFIBUS send status word 1	Vector	r2129[15]	No alarm therm. overload power section	Vector
p2088	PROFIBUS invert status word	Vector	B800h		Vector
p2128[14]	Selecting fault/alarm code for trigger	Vector	7910	Alarm, motor overtemperature	Vector
p2128[15]	Selecting fault/alarm code for trigger	Vector	5000	Alarm therm. overload power section	Vector
p2153	Time constant revolutions actual value filter	Vector	20 ms		Vector
p4053[0]	Smoothing time constant, analog inputs (TM31)	TM31	0 ms		TM31
p4053[1]	Smoothing time constant, analog inputs (TM31)	TM31			TM31
p4056[0]	Analog inputs, type	TM31	2	Current 0...20 mA	TM31
p4056[1]	Analog inputs, type	TM31	2	Current 0...20 mA	TM31
p4076[0]	Analog outputs, type	TM31	0	Current 0...20 mA	TM31
p4076[1]	Analog outputs, type	TM31	0	Current 0...20 mA	TM31
p4071[0]	Signal analog output 0	TM31	r0063	Actual speed, smoothed	TM31
p4071[1]	Signal analog output 1	TM31	r0068	Absolute current actual value	TM31
p4100	Temperature sensor type	TM31	0	(factory setting)	TM31
p4102[0]	TM31 temperature evaluation fault/alarm threshold	TM31	251 °C	Message being generated	TM31
p4102[1]	TM31 temperature evaluation fault/alarm threshold	TM31	251 °C	Message being generated	TM31
p7003	Winding system	Vector	1	Separate winding systems	Vector

Parameter macro p0700 = S/G150 PROFIBUS (70005)

This macro is used to set the PROFIBUS interface as the command source.

Table 2 Parameter macro p0700 = S/G150 PROFIBUS

Sink			Source		
Parameter	**Description**	**DO**	**Parameter**	**Description**	**DO**
p0840[0]	ON/OFF1	Vector	r2090.0	PZD 1 Bit 0	Vector
p0844[0]	No OFF2_1	Vector	r2090.1	PZD 1 Bit 1	Vector
p0845[0]	No OFF2_2	Vector	r0722.3	CU DI3	CU
p0848[0]	No OFF3_1	Vector	r2090.2	PZD 1 Bit 2	Vector
p0849[0]	No OFF3_2	Vector	r0722.2	CU DI2	CU
p0806	LOCAL mode disable	Vector	0		
p0810	Command data set selection CDS bit 0	Vector	0		
p0852	Enable operation	Vector	r2090.3	PZD 1 Bit 3	Vector
p0854	Control from the PLC	Vector	r2090.10	PZD 1 Bit 10	Vector
p0922	PROFIBUS PZD telegram selection	Vector	999	Customizable message frame configuration	
p1020	Fixed setpoint selection bit 0	Vector	0		
p1021	Fixed setpoint selection bit 1	Vector	0		
p1035	MOP raise	Vector	r2090.13	PZD 1 Bit 13	Vector
p1036	MOP lower	Vector	r2090.14	PZD 1 Bit 14	Vector
p1055	Jog bit 0	Vector	0		
p1056	Jog bit 1	Vector	0		
p1113	Direction reversal	Vector	r2090.11	PZD 1 Bit 11	Vector
p1140	Enable RFG	Vector	r2090.4	PZD 1 Bit 4	Vector
p1141	Start RFG	Vector	r2090.5	PZD 1 Bit 5	Vector
p1142	Enable speed setpoint	Vector	r2090.6	PZD 1 Bit 6	Vector
p2103	1st acknowledge faults	Vector	r2090.7	PZD 1 Bit 7	Vector
p2104	2nd acknowledge faults	Vector	r4022.3	TM31 DI3	TM31
p2106	External fault 1	Vector	r0722.1	CU DI1	CU
p2107	External fault 2	Vector	1		
p2112	External alarm 1	Vector	r0722.0	CU DI0	CU
p2116	External alarm 2	Vector	1		
p0738	DI/DO8	CU	1	+24 V	CU
p0748[8]	Invert DI/DO8	CU	0	not inverted	
p0728[8]	Set DI/DO8 input or output	CU	1	Output	CU
p0739	DI/DO9	CU	1	+24 V	CU
p0748[9]	Invert DI/DO9	CU	0	not inverted	
p0728[9]	Set DI/DO9 input or output	CU	1	Output	CU

Sink			Source		
Parameter	**Description**	**DO**	**Parameter**	**Description**	**DO**
p0740	DI/DO10	CU	1	+24 V	CU
p0748[10]	Invert DI/DO10	CU	0	not inverted	
p0728[10]	Set DI/DO10 input or output	CU	1	Output	CU
p0741	DI/DO11	CU	1	+24 V	CU
p0748[11]	Invert DI/DO11	CU	0	not inverted	
p0728[11]	Set DI/DO11 input or output	CU	1	Output	CU
p0742	DI/DO12	CU	1	+24 V	CU
p0748[12]	Invert DI/DO12	CU	0	not inverted	
p0728[12]	Set DI/DO12 input or output	CU	1	Output	CU
p0743	DI/DO13	CU	r0899.6	Power-on inhibit	Vector
p0748[13]	Invert DI/DO13	CU	1	inverted	
p0728[13]	Set DI/DO13 input or output	CU	1	Output	CU
p0744	DI/DO14	CU	1	+24 V	CU
p0748[14]	Invert DI/DO14	CU	0	not inverted	
p0728[14]	Set DI/DO14 input or output	CU	1	Output	CU
p0745	DI/DO15	CU	r2138.7	Acknowledge fault	Vector
p0748[15]	Invert DI/DO15	CU	0	not inverted	
p0728[15]	Set DI/DO15 input or output	CU	1	Output	CU
p2103	1st acknowledge faults	TM31	r2090.7	PZD 1 Bit 7	Vector
p2104	2nd acknowledge faults	TM31	r4022.3	TM31 DI3	TM31
p4030	DO0	TM31	r0899.11	Pulses enabled	Vector
p4031	DO1	TM31	r2139.3	Fault	Vector
p4038	DO8	TM31	r0899.0	Ready to power up	Vector
p4028.8	Set DI/DO8 input or output	TM31	1	Output	TM31
p4039	DO9	TM31	0		
p4028.9	Set DI/DO9 input or output	TM31	0		
p4040	DO10	TM31	0		
p4028.10	Set DI/DO10 input or output	TM31	0		
p4041	DO11	TM31	0		
p4028.11	Set DI/DO11 input or output	TM31	0		
p2103	1st acknowledge faults	A_INF	r2090.7	PZD 1 Bit 7	Vector
p2104	2nd acknowledge faults	A_INF	r4022.3	TM31 DI3	TM31

Parameter macro p0700 = S/G150 terminal block (70006)

This macro is used to set customer terminal block TM31 as the command source.

Table 3 Parameter macro p0700 = S/G150 terminal block

Sink			Source		
Parameter	**Description**	**DO**	**Parameter**	**Description**	**DO**
p0840[0]	ON/OFF1	Vector	r4022.0	TM31 DI0	TM31
p0844[0]	OFF2_1 enable signal missing	Vector	1		
p0845[0]	OFF2_2 enable signal missing	Vector	r0722.3	CU DI3	CU
p0848[0]	OFF3_1 enable signal missing	Vector	1		
p0849[0]	OFF3_2 enable signal missing	Vector	r0722.2	CU DI2	CU
p0806	LOCAL mode disable	Vector	0		
p0810	Command data set selection CDS bit 0	Vector	0		
p0852	Enable operation	Vector	r4022.4	TM31 DI4	TM31
p0854	Control from the PLC	Vector	1		
p0922	PROFIBUS PZD telegram selection	Vector	999	Customizable message frame configuration	
p1020	Fixed setpoint selection bit 0	Vector	r4022.1	TM31 DI1	TM31
p1021	Fixed setpoint selection bit 1	Vector	r4022.2	TM31 DI2	TM31
p1035	MOP raise	Vector	r4022.1	TM31 DI1	TM31
p1036	MOP lower	Vector	r4022.2	TM31 DI2	TM31
p1055	Jog bit 0	Vector	0		
p1056	Jog bit 1	Vector	0		
p1113	Direction reversal	Vector	0		
p1140	Enable RFG	Vector	1		
p1141	Start RFG	Vector	1		
p1142	Enable speed setpoint	Vector	1		
p2103	1st acknowledge faults	Vector	0		
p2104	2nd acknowledge faults	Vector	r4022.3	TM31 DI3	TM31
p2106	External fault 1	Vector	r0722.1	CU DI1	CU
p2107	External fault 2	Vector	1		
p2112	External alarm 1	Vector	r0722.0	CU DI0	CU
p2116	External alarm 2	Vector	1		
p0738	DI/DO8	CU	1	+24 V	CU
p0748[8]	Invert DI/DO8	CU	0	not inverted	
p0728[8]	Set DI/DO8 input or output	CU	1	Output	CU

Sink			Source		
Parameter	**Description**	**DO**	**Parameter**	**Description**	**DO**
p0739	DI/DO9	CU	1	+24 V	CU
p0748[9]	Invert DI/DO9	CU	0	not inverted	
p0728[9]	Set DI/DO9 input or output	CU	1	Output	CU
p0740	DI/DO10	CU	1	+24 V	CU
p0748[10]	Invert DI/DO10	CU	0	not inverted	
p0728[10]	Set DI/DO10 input or output	CU	1	Output	CU
p0741	DI/DO11	CU	1	+24 V	CU
p0748[11]	Invert DI/DO11	CU	0	not inverted	
p0728[11]	Set DI/DO11 input or output	CU	1	Output	CU
p0742	DI/DO12	CU	1	+24 V	CU
p0748[12]	Invert DI/DO12	CU	0	not inverted	
p0728[12]	Set DI/DO12 input or output	CU	1	Output	CU
p0743	DI/DO13	CU	r0899.6	Power-on inhibit	Vector
p0748[13]	Invert DI/DO13	CU	1	inverted	
p0728[13]	Set DI/DO13 input or output	CU	1	Output	CU
p0744	DI/DO14	CU	1	+24 V	CU
p0748[14]	Invert DI/DO14	CU	0	not inverted	
p0728[14]	Set DI/DO14 input or output	CU	1	Output	CU
p0745	DI/DO15	CU	r2138.7	Acknowledge fault	Vector
p0748[15]	Invert DI/DO15	CU	0	not inverted	
p0728[15]	Set DI/DO15 input or output	CU	1	Output	CU
p2103	1st acknowledge faults	TM31			
p2104	2nd acknowledge faults	TM31	r4022.3	TM31 DI3	TM31
p4030	DO0	TM31	r0899.11	Pulses enabled	Vector
p4031	DO1	TM31	r2139.3	Fault	Vector
p4038	DO8	TM31	r0899.0	Ready to power up	Vector
p4028.8	Set DI/DO8 input or output	TM31	1	Output	TM31
p4039	DO9	TM31		Factory setting	
p4028.9	Set DI/DO9 input or output	TM31		Factory setting	
p4040	DO10	TM31		Factory setting	
p4028.10	Set DI/DO10 input or output	TM31		Factory setting	
p4041	DO11	TM31		Factory setting	
p4028.11	Set DI/DO11 input or output	TM31		Factory setting	
p2103	1st acknowledge faults	A_INF	0		
p2104	2nd acknowledge faults	A_INF	r4022.3	TM31 DI3	TM31

Parameter macro p0700 = S/G150 NAMUR (70007)

This macro is used to set the NAMUR terminal block as the command source.

Table 4 Parameter macro p0700 = S/G150 NAMUR

Sink			Source		
Parameter	**Description**	**DO**	**Parameter**	**Description**	**DO**
p0840[0]	ON/OFF1	Vector	r4022.0	TM31 DI0	TM31
p0844[0]	OFF2_1 enable signal missing	Vector	r4022.4	TM31 DI4	TM31
p0845[0]	OFF2_2 enable signal missing	Vector	r0722.3	CU DI3	CU
p0848[0]	OFF3_1 enable signal missing	Vector	r4022.5	TM31 DI5	TM31
p0849[0]	OFF3_2 enable signal missing	Vector	1		
p0806	LOCAL mode disable	Vector	0		
p0810	Command data set selection CDS bit 0	Vector	0		
p0852	Enable operation	Vector	1		
p0854	Control from the PLC	Vector	1		
p0922	PROFIBUS PZD telegram selection	Vector	999	Customizable message frame configuration	
p1020	Fixed setpoint selection bit 0	Vector	r4022.1	TM31 DI1	TM31
p1021	Fixed setpoint selection bit 1	Vector	r4022.2	TM31 DI2	TM31
p1035	MOP raise	Vector	r4022.1	TM31 DI1	TM31
p1036	MOP lower	Vector	r4022.2	TM31 DI2	TM31
p1055	Jog bit 0	Vector	0		
p1056	Jog bit 1	Vector	0		
p1113	Direction reversal	Vector	r4022.6	TM31 DI6	TM31
p1140	Enable RFG	Vector	1		
p1141	Start RFG	Vector	1		
p1142	Enable speed setpoint	Vector	1		
p2103	1st acknowledge faults	Vector	0		
p2104	2nd acknowledge faults	Vector	r4022.3	TM31 DI3	TM31
p2106	External fault 1	Vector	r0722.1	CU DI1	CU
p2107	External fault 2	Vector	1		
p2112	External alarm 1	Vector	r0722.0	CU DI0	CU
p2116	External alarm 2	Vector	1		
p0738	DI/DO8	CU	1	+24 V	CU
p0748[8]	Invert DI/DO8	CU	0	not inverted	
p0728[8]	Set DI/DO8 input or output	CU	1	Output	CU

Sink			Source		
Parameter	**Description**	**DO**	**Parameter**	**Description**	**DO**
p0739	DI/DO9	CU	1	+24 V	CU
p0748[9]	Invert DI/DO9	CU	0	not inverted	
p0728[9]	Set DI/DO9 input or output	CU	1	Output	CU
p0740	DI/DO10	CU	1	+24 V	CU
p0748[10]	Invert DI/DO10	CU	0	not inverted	
p0728[10]	Set DI/DO10 input or output	CU	1	Output	CU
p0741	DI/DO11	CU	1	+24 V	CU
p0748[11]	Invert DI/DO11	CU	0	not inverted	
p0728[11]	Set DI/DO11 input or output	CU	1	Output	CU
p0742	DI/DO12	CU	1	+24 V	CU
p0748[12]	Invert DI/DO12	CU	0	not inverted	
p0728[12]	Set DI/DO12 input or output	CU	1	Output	CU
p0743	DI/DO13	CU	r0899.6	Power-on inhibit	Vector
p0748[13]	Invert DI/DO13	CU	1	inverted	
p0728[13]	Set DI/DO13 input or output	CU	1	Output	CU
p0744	DI/DO14	CU	1	+24 V	CU
p0748[14]	Invert DI/DO14	CU	0	not inverted	
p0728[14]	Set DI/DO14 input or output	CU	1	Output	CU
p0745	DI/DO15	CU	r2138.7	Acknowledge fault	Vector
p0748[15]	Invert DI/DO15	CU	0	not inverted	
p0728[15]	Set DI/DO15 input or output	CU	1	Output	CU
p2103	1st acknowledge faults	TM31			
p2104	2nd acknowledge faults	TM31	r4022.3	TM31 DI3	TM31
p4030	DO0	TM31	r0899.11	Pulses enabled	Vector
p4031	DO1	TM31	r2139.3	Fault	Vector
p4038	DO8	TM31	r0899.0	Ready to power up	Vector
p4028.8	Set DI/DO8 input or output	TM31	1	Output	TM31
p4039	DO9	TM31		Factory setting	
p4028.9	Set DI/DO9 input or output	TM31		Factory setting	
p4040	DO10	TM31		Factory setting	
p4028.10	Set DI/DO10 input or output	TM31		Factory setting	
p4041	DO11	TM31		Factory setting	
p4028.11	Set DI/DO11 input or output	TM31		Factory setting	
p2103	1st acknowledge faults	A_INF	0		
p2104	2nd acknowledge faults	A_INF	r4022.3	TM31 DI3	TM31

Parameter macro p0700 = S/G150 PROFIdrive NAMUR (70010)

With this macro, the PROFIdrive NAMUR interface is pre-set (as default) as command source.

Table 5 Parameter macro p0700 = S/G150 PROFIdrive NAMUR

Sink			Source		
Parameter	**Description**	**DO**	**Parameter**	**Description**	**DO**
p0840[0]	ON/OFF1	Vector		p0922	
p0844[0]	No OFF2_1	Vector		p0922	
p0845[0]	No OFF2_2	Vector	r0722.3	CU DI3	CU
p0848[0]	No OFF3_1	Vector		p0922	
p0849[0]	No OFF3_2	Vector	1		
p0806	Inhibit LOCAL mode	Vector			
p0810	Switchover CDS bit 0	Vector			
p0852	Enable operation	Vector	1	p0922	
p0854	Control from the PLC	Vector	1	p0922	
p0922	Profibus PZD telegram selection	Vector	20	PROFIdrive NAMUR	
p1020	FSW bit 0	Vector			
p1021	FSW bit 1	Vector			
p1035	MOP raise	Vector			
p1036	MOP lower	Vector			
p1055	Jog bit 0	Vector			
p1056	Jog bit 1	Vector			
p1113	Direction of rotation changeover	Vector		p0922	
p1140	Enable RFG	Vector	1	p0922	
p1141	Start RFG	Vector	1	p0922	
p1142	Enable nsetp	Vector	1	p0922	
p2103	Acknowledge fault_1	Vector	0	p0922	
p2104	Acknowledge fault_2	Vector	0		
p2106	Ext. fault_1	Vector	r0722.1	CU DI1	CU
p2107	Ext. fault_2	Vector	1		
p2112	Ext. alarm_1	Vector	r0722.0	CU DI0	CU
p2116	Ext. alarm_2	Vector	1		
p0738	DI/DO8	CU	1	+24 V	CU
p0748[8]	Invert DI/DO8	CU	0	Not inverted	
p0728[8]	Set DI/DO8 input or output	CU	1	Output	CU
p0739	DI/DO9	CU	1	+24 V	CU
p0748[9]	Invert DI/DO9	CU	0	Not inverted	
p0728[9]	Set DI/DO9 input or output	CU	1	Output	CU
p0740	DI/DO10	CU	1	+24 V	CU

Sink			Source		
Parameter	**Description**	**DO**	**Parameter**	**Description**	**DO**
p0748[10]	Invert DI/DO10	CU	0	Not inverted	
p0728[10]	Set DI/DO10 input or output	CU	1	Output	CU
p0741	DI/DO11	CU	1	+24 V	CU
p0748[11]	Invert DI/DO11	CU	0	Not inverted	
p0728[11]	Set DI/DO11 input or output	CU	1	Output	CU
p0742	DI/DO12	CU	1	+24 V	CU
p0748[12]	Invert DI/DO12	CU	0	Not inverted	
p0728[12]	Set DI/DO12 input or output	CU	1	Output	CU
p0743	DI/DO13	CU	r0899.6	Power-up inhibit	Vector
p0748[13]	Invert DI/DO13	CU	1	inverted	
p0728[13]	Set DI/DO13 input or output	CU	1	Output	CU
p0744	DI/DO14	CU	1	+24 V	CU
p0748[14]	Invert DI/DO14	CU	0	Not inverted	
p0728[14]	Set DI/DO14 input or output	CU	1	Output	CU
p0745	DI/DO15	CU	r2138.7	Ack. fault	Vector
p0748[15]	Invert DI/DO15	CU	0	Not inverted	
p0728[15]	Set DI/DO15 input or output	CU	1	Output	CU
p2103	Acknowledge fault 1	TM31			
p2104	Acknowledge fault 2	TM31			
p4030	DO0	TM31			
p4031	DO1	TM31			
p4038	DO8	TM31		Factory setting	
p4028.8	Set DI/DO8 input or output	TM31		Factory setting	
p4039	DO9	TM31		Factory setting	
p4028.9	Set DI/DO9 input or output	TM31		Factory setting	
p4040	DO10	TM31		Factory setting	
p4028.10	Set DI/DO10 input or output	TM31		Factory setting	
p4041	DO11	TM31		Factory setting	
p4028.11	Set DI/DO11 input or output	TM31		Factory setting	
p2103	Acknowledge fault 1	A_INF	0		
p2104	Acknowledge fault 2	A_INF	r4022.3	TM31 DI3	TM31

Parameter macro p1000 = PROFIBUS (100001)

This macro is used to set PROFIBUS as the setpoint source.

Table 6 Parameter macro p1000 = PROFIBUS

Sink			Source		
Parameter	**Description**	**DO**	**Parameter**	**Description**	**DO**
p1070	Main setpoint	Vector	r2050[1]	PROFIBUS PZD2	Vector
p1071	Main setpoint scaling	Vector	1	100 %	Vector
p1075	Suppl setpoint	Vector	0		Vector
p1076	Additional setpoint scaling	Vector	1	100 %	Vector

Parameter macro p1000 = AI0 – TM31 (100002)

This macro is used to set analog input 0 on customer terminal block TM31 as the setpoint source.

Table 7 Parameter macro p1000 = AI0 – TM31

Sink			Source		
Parameter	**Description**	**DO**	**Parameter**	**Description**	**DO**
p1070	Main setpoint	Vector	r4055	AI0 TM31	TM31
p1071	Main setpoint scaling	Vector	1	100 %	TM31
p1075	Suppl setpoint	Vector	0		TM31
p1076	Additional setpoint scaling	Vector	1	100 %	TM31

Parameter macro p1000 = motorized potentiometer (100003)

This macro is used to set the motorized potentiometer as the setpoint source.

Table 8 Parameter macro p1000 = motorized potentiometer

Sink			Source		
Parameter	**Description**	**DO**	**Parameter**	**Description**	**DO**
p1070	Main setpoint	Vector	r1050	Motorized potentiometer	Vector
p1071	Main setpoint scaling	Vector	1	100 %	Vector
p1075	Suppl setpoint	Vector	0		Vector
p1076	Additional setpoint scaling	Vector	1	100 %	Vector

Parameter macro p1000 = fixed setpoint (100004)

This macro is used to set the fixed setpoint as the setpoint source.

Table 9 Parameter macro p1000 = fixed setpoint

Sink			Source		
Parameter	**Description**	**DO**	**Parameter**	**Description**	**DO**
p1070	Main setpoint	Vector	r1024	Effective fixed setpoint	Vector
p1071	Main setpoint scaling	Vector	1	100 %	Vector
p1075	Suppl setpoint	Vector	0		Vector
p1076	Additional setpoint scaling	Vector	1	100 %	Vector

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